Approaches for Treatment of Retained Placenta in Cross-bred Dairy Cows and their Effect on the Postpartum Period

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Dedication

To my parent and brothers

To everyone supports me through my gloomy days

And

to those who give me unconditional love through my daily life

to accept God's pardon quietly.

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Abstract

In this study, 231 cross bred dairy cows (Butana x Friesian) were used to determine the incidence of retained placenta in Khartoum State, its effect on postpartum reproductive traits and to validate the success rate of three methods of treatment in maintaining normal fertility levels after parturition. The influences of age, parity, body weight, foreign blood percentage and season on recovery rate were also studied.

The animals were divided into four groups. The control group (C) consisted of 84 cows, in which the placenta was expelled normally (within12 hours) and no treatment was applied. The rest of the animals were all diagnosed as having retained placenta and they were randomly divided into three treatment groups. The first group (G1) was treated with manual removal of the placenta, intrauterine Tetracycline pessaries and intramuscular (I/m) injection of Oxytetracycline. The second group (G2) received the same treatment as (G1) in addition to (I/m) injection of ($PGF_{2}\alpha$). The third group (G3) was treated as (G2) with the exception that, ($PGF_{2}\alpha$) was administered at two weeks postpartum.

Rectal palpation was conducted, once weekly, to monitor the progress of uterine involution and the commencement of ovarian activities. Body weight changes were also recorded weekly using Dalton's weigh band.

The results of the postpartum reproductive traits obtained in the four groups (C), (G1), (G2) and (G3) showed as follows, the over all averages period achieved for complete uterine involution were at 29.44±7.93 days, 25.12±7.25 days, 22.65±8.04 days and 23.19±4.78 days, respectively, while the first detected ovarian activities were indicated at 38.27±13.54 days, 47.46±22.07 days, 44.28±23.58 days and 42.46±21.96

days, respectively. Occurrences of first observable postpartum oestrus attained at 53.90±24.11 days, 45.16±20.34 days, 48.84±25.46 days and 41.93±16.03 days, respectively, while the numbers of services per conception recorded were 3.05±2.13, 3.55±1.81, 3.26±1.79 and 2.81±1.59, respectively. The open periods recorded were 115.39±22.98 days, 114.99±34.78 days, 114.51±28.33 days and 98.68±25.00 days, respectively.

The results revealed that the three treatment groups recorded significantly shorter periods for completion of uterine involution, commencement of ovarian activities and occurrence of first observable postpartum oestrus. Number of services per conception and length of the open period showed no significant difference between the control group and treatment groups (1) and (2). However, records obtained for these reproductive traits in treatment group (3) were significantly superior to those of other groups.

Old Age, parity and loss of body weight were among the factors found to influence, adversely, uterine involution, ovarian activities, occurrence of first observable postpartum oestrus and consequently the length of the open period. Foreign blood percentage showed variable effect on postpartum reproductive traits, ranging between weak and moderate significance. Comparison of results obtained in the different season revealed that, summer had an adverse effect on postpartum reproductive traits in all groups, while better record, were encountered in autumn and winter.

ملخص الأطروحة

في هذه الدراسة تم استخدام ٢٣١ بقرة هجين (بطانة X فريزيان) لتحديد نسبة حدوث احتباس المشيمة بولاية الخرطوم و أثرها علي الصفات التناسلية بعد الولادة ولمقارنة معدلات نجاح ثلاث طرق للعلاج في استعادة المعدلات الطبيعية للخصوبة في الابقار المصابة. كما تمت دراسة أثر العمر، عدد الولادات، وزن الجسم، نسبة الدم الاجنبى والموسم علي درجة الاستجابة للعلاج في استعادة الخصوبة لمستوياتها قبل الولادة.

تم تقسيم الأبقار إلي أربع مجموعات مجموعة التحكم (C) وتحتوي علي ٨٤ بقرة سقطت مشائمها خلال ١٢ ساعة بعد الولادة بشكل طبيعي ولم يستخدم فيها أي نوع من العلاج. بقية الأبقار تم تشخيصها علي أنها محتبسة المشيمة وقسمت عشوائيا الي ثلاث مجموعات علاجية. المجموعة الأولي (G1) تم علاجها بالازالة اليدوية للمشيمة و وضع لبوسات رحمية (تتراسيكلين) مع حقن مضاد حيوي بالعضل (الأوكسي تتراسيكلين). المجموعة الثانية (G2) تلقت نفس علاج المجموعة الأولي (G1) زائدا حقن هرمون (PGF2α) في العضل. المجموعة الثالثة (G3) عولجت كما في المجموعة الثانية (G2) مع الفرق في أن حقن هرمون (PGF2α) تم في اليوم الرابع عشر بعد الولادة.

عملية ارتداد الرحم وعودة نشاط المبيضين تمت متابعتها بالجس عن طريق المستقيم مرة في الأسبوع كما تمت متابعة التغييرات في وزن الجسم بقياس محيط الصدر أسبوعيا باستخدام شريط دالتون.

خلاصة نتائج الصفات التناسلية بعد الولادة للمجموعات الأربعة (C)، (G1)، (G2) و (G3) كانت كالاتي، متوسط ارتداد الرحم كان 29.44±7.93 يوم، 25.12±7.25 يوم ، 22.65±8.04 يوم و 23.19±4.78 يوم، بالتسلسل، بينما سجل متوسط عودة المبيضين لنشاطهما 38.27±13.54 يوم، 47.46±22.07 يوم ، 44.28±23.58 يوم و 42.46±21.96 يوم، بالتسلسل. متوسط ظهور أول شبق بعد الولادة كان 53.90±24.11 يوم، 45.16±20.34 يوم، 48.84±25.46 يوم و 41.93±16.03 يوم، بالتسلسل. متوسط عدد التلقيحات اللازمة للحمل كان 2.13 ±3.05 ، 3.55±1.81، 3.26±1.79 و 2.81±1.59، بالتسلسل. طول الفترة ما بين آخر ولادة والحمل التالي كان بمتوسط 115.39±22.98 يوم، 114.99±34.78 يوم ، 114.51±28.33 يوم و 98.68±25.00 يوم ، متسلسلة.

أظهرت الدراسة أن مجموعات المعالجة الثلاث أعطت نتائج أفضل من مجموعة التحكم فيما يختص بتقصير الفترة اللازمة لارتداد الرحم وعودة نشاط المبيضين وظهور أول دورة شبق بعد الولادة . الا أن عدد التلقيحات اللازمة لحدوث الحمل وطول الفترة المفتوحة كان أقل في المجموعة الثالثة (G3) مقارنة ببقية

المجموعات. كما سجلت المجموعة الثالثة (G3) أفضل أداء في جميع الصفات التناسلية مقارنة بمجموعتي العلاج (G1) و(G2).

من ضمن العوامل التي أثبتت الدراسة تأثيرها السلبي علي عودة معدلات الخصوبة الي مستواها قبل الولادة وعلي الاستجابة لعلاج احتباس المشيمة، تقدم العمر، زيادة عدد الولادات وفقدان الوزن. نسبة الدم الأجنبي (فريزيان) أظهرت تأثيرات متفاوتة في كل المجموعات تراوحت بين متوسط وضعيف من الناحية المعنوية.

بالنسبة لأثر الموسم في معدلات حدوث احتباس المشيمة واستعادة معدلات الخصوبة الطبيعية فقد كشفت الدراسة أن أسوأ النتائج سجلت في موسم الصيف مع التحسن الواضح في الأداء خلال الخريف والشتاء وذلك في جميع المجموعات.

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Introduction

Sudan has a huge livestock sector which participates substantially in the economy of the country through The Gross National Production and total foreign hard currency revenue. The livestock sector provides jobs to nearly half of the Sudanese citizens and plays a major role in promoting the food security of the country.

Economic conditions in the dairy industry challenge dairy farmers, especially in Khartoum State, to find ways to increase farm profitability in order to stay competitive. Thus animal reproductive health should be the priority so as to achieve that purpose.

Before the establishment of the Artificial Insemination Centre in 1976 in Hilat Kuku area milk supplies in Khartoum State came from local Northern Sudan breed (Kenana and Butana), currently, cross bred cows constitute more than 90% of cattle population. However, continuous cross breeding lead to many problems including infertility and production insufficiency.

Retained placenta, frequently connected with metritis, is one of the main reasons for decrease in the reproductive abilities of cows and heifers. Approximately one hundred caruncles are formed in the placenta during the gestation period and the foetal and uterine tissue increased in size to a connective area (Schalfer et al., 2000; Russe et al., 1991; Grunert et al., 1993).

Placental retention in cattle includes the retention of foetal membranes that did not separate within the first twelve hours after parturition and affects other reproductive systems (Werven et al., 1992).

Grunert et al., (1993) estimated that placenta retention normally occur in 3 to 8 percent of cattle although in some breeds this percentage can increase beyond 60 percent. Placental retention appears in 40 to 70 percent of cows with induced parturition (Konigsson, 2001).

The secondary conditions that retained placenta and metritis constitute the major reasons that cows leave the herd by early culling (Kelton et al., 1998). The post-partum uterine environment is in constant contact with fluid and tissue debris that can support bacterial growth. Bacterial contamination occurs in up to 90 percent of dairy cows during the first week postpartum while infectious placental retention is often related with zoonoses like Brucellosis, Salmonellosis, Leptospirosis and Listeriosis (Wallace, 2005). Placentitis and subsequent retained placenta can also be caused by bacteria like Streptococcus and Micrococcus species. The outcome of uterine contamination depends on the number and virulence of the organisms present as well as the condition of the uterus and its inherent defense mechanisms (Wallace, 2005).

Many different bacteria can be isolated from the early postpartum uterus. Most of these are environmental contaminants that are gradually eliminated during the first six weeks post calving (Wallace, 2005). Normal postpartum cows will resolve uterine infections by rapid involution of the uterus and cervix, discharge of uterine contents, and mobilization of natural defense mechanisms (Wallace, 2005). Cows with certain periparturient problems have reduced ability to control uterine infections (Wallace, 2005). Excessive stretching of the uterus (such as twins or calving difficulties) or metabolic disorders can decrease uterine contractility. This leads to retention of fluid and membranes beyond the normal period providing excellent media for bacterial growth. Calving problems, retained placenta and metritis reduce the ability of uterine white blood cells to remove bacteria (Wallace, 2005). The duration of infertility associated with uterine infection depends on the severity and duration of inflammation. Resolution of the inflammation occurs with time. Normally, fertility is restored by 40 to 50 days postpartum (Wallace, 2005).

Retained placenta / metritis complex is a multi-factorial disease. Factors that can contribute to uterine disease include shortened gestational length (abortions), twinning, infectious diseases, and improper assistance during delivery, stress, and nutritional imbalances such as energy and protein deficiencies, phosphorus and vitamin A deficiencies, and vitamin E and selenium deficiencies (Wallace, 2005). Over conditioned dry cows are at higher risk for retained placenta. Imbalanced nutrient leading to subclinical hypocalcaemia has been associated with inefficient uterine contractility (Wallace, 2005). Cows may be able to expel their placenta, but uterine involution may be delayed leading to infection and inflammations. Reducing or eliminating these conditions will allow cows to start their lactation profitably (Wallace, 2005).

The treatment of retained placentae has remained unchanged for some decades and is primarily focused on the removal of the pathological contents from the uterus. Many of the treatments used are based on manual extraction, chemotherapy including antibiotics and hormones injections, and inserting intrauterine pessaries.

Objectives:

This study was designed to fulfill the following objectives:

1- To investigate the incidence of retained placenta in cross bred dairy cows and its effect on postpartum reproductive trait.

2- To study the influence of age and season on incidence of retained placenta.

3- To verify the efficacy of three different treatment procedures in restoring reproductive performance of cross bred cows affected by retained placenta.

Chapter one (1)

Literature review

1.1: Postpartum period:

Postnatal (Latin for 'after birth') is the period beginning immediately after the birth of a foetus and extending for about six weeks. The period is also known as postpartum and, less commonly, puerperium (Word net dictionary, 2006). In postpartum period the dam body, including hormone levels and uterine size, return to normal conditions.

Many diseases occur in this period and the immediate complications involve haemorrhage, lacerations, rupture of the reproductive organs, prolapses of the uterus, displaced abomasum and metabolic diseases (Stevenson and Call, 1988; Gröhn et al., 1990; Correa et al., 1993; Lewis, 1997).

The reproductive problems that develop subsequently are as follows retained foetal membranes, metritis-pyometra complex, cystic ovaries, anoestrus, repeat breeding, and early embryonic death. The goal expected from postpartum period management is to have less pathologic events and high reproductive performance within the constraints of practical and economic reality (Peters, 1999).

The postpartum period forms a very critical part of the calving interval (annual reproductive cycle) and influences the duration of this interval. The calving interval is comprised of an elective waiting time, interval from last breeding to conception, and gestation length. The achievement of a mean calving to conception interval of 85 to 115 days requires concentrated management activity during the first 90 days following calving. Ideally cows should be bred at the first heat after 50 days (Peters, 1999).

1.2: Postpartum reproductive performance:

1.2.1: Uterine involution process:

Involution of the uterus involves loss of intraluminal fluid, reduction in size, and endometrial repair (Peters, 1999). At the time of parturition, the uterine lumen holds approximately 70 kg that includes fluids, foetal membranes, and the foetus (Peters, 1999). Approximately half of this weight is fluids, and the other half constitutes foetus and membranes. Uterine fluids, or 'lochia', are expelled in copious amounts during the first 10 to 12 days postpartum, but expulsion is completed by day 14 to 18, if involution is normal (Peters, 1999). The lochia is normally brownish-red for the first 8 or 9 days after calving. When caruncles (maternal side of the placenta) begin to slough 10 to 12 days postpartum, the lochia may contain increased amounts of blood (Hafez and Hafez, 2000). The uterus decreases in weight from 9 to 11 kg at parturition to less than 1 kg by day 25 to 30 postpartum. Both weight and size reduction is greatest during the first few days after parturition. By 20 days postpartum, the size of the uterus is reduced by more than 80 percent. By 40 days, the uterus is completely involutes and the rate of involution is influenced by the periparturient problems (Peters, 1999).

1.2.2: Ovarian activity

Cows with the longest intervals from calving to first ovulation produce more milk and also had prolonged intervals to first oestrous activity. Differences in follicular dynamics before first ovulation alter intervals to first oestrus, first service, and uterine involution, but these differences did not affect pregnancy rate, number of services, and days open. First postpartum insemination after 3 follicular waves tended to have greater pregnancy rates than those after two follicular waves. Acceptable reproductive efficiency requires each cow to calve regularly to maximize economic output of milk production (Lucy, 2001; Roche, 2000).

Rapid progress in genetics and management in the dairy industry has resulted in increased milk production per cow. Metabolic demands for more milk have negative impact on reproductive function of postpartum cow (Beam and Butler, 1999). Those with the greatest milk production have the highest incidence of infertility, but epidemiological studies indicate, in addition to milk production, other factors probably contribute to decreasing reproductive efficiency in dairy herds (Lucy, 2001).

In dairy cows, resumption of ovarian activity plays an important role in subsequent fertility (Darwash et al., 1997; Smith and Wallace, 1998). Ultrasound imaging technique applied to the study of bovine follicular dynamic revealed that most postpartum follicular development occurs in a wave-like manner in normal cycling cattle (Rajamahendran and Tylor, 1990; Savio et al., 1990a).

Further studies revealed that postpartum anovulatory anoestrus in dairy cows is not due to a lack of follicular development, but rather the failure of a dominant follicle to ovulate (Roche et al., 2000). The first dominant follicle is selected within 10 days after calving in nearly all dairy cows, independent of subsequent reproductive performance (Savio et al., 1990a; McDougall et al., 1995). First ovulation can be observed within two weeks after calving in dairy cows (Rajamahendran and Tylor, 1990; Savio et al., 1990a; Mc McDougall et al., 1995).

1.2.3: Number of services per conception:

The number of services per conception depends largely on the breeding system used. It is higher under uncontrolled natural breeding and low where hand-mating or artificial insemination is used (Choudhuri et al., 1984). Number of services per conception greater than 2.0 should be regarded as poor. A number of factors were found to contribute high number of services per conception. Choudhuri et al., (1984) estimated the repeatability of number of services per conception to be 19 % from 2152 records for Haryana cattle. The number of services per conception was 2.81±0.03 and was significantly affected by herd, season, placenta expulsion time, lactation length and milk yield. Since heritability can be broadly estimated from repeatability, heritability of number of services per conception is low and most of the variation is attributable to environmental factors. Gang et al., (2002) reported that the high insulin inducing diet improves the conception rate.

1.2.4: Days open:

Estimation of average days open is a way to assess the reproductive efficiency in a herd. Days open is defined as the interval from calving to the time of successful breeding and is made up of three major components (Shearer, 1992).

An elective-waiting period forms the first component and is partly a management decision. The period is also referred to as voluntary wait period. This period varies from 40 to 70 days on most farms (Peters, 1999). Part of this period is meant to be a time of recuperation for the cow and its reproductive tract (Peters, 1999).

The reproductive tract goes under involution process. When cows calve without complications, the involution process (both macro- and microscopic) prepares the reproductive tract for another pregnancy. Peripartum (period around parturition) complications can delay this process appreciably (Peters, 1999).

The period of time between the end of the elective-waiting period and the detection of first oestrus is the second component. The duration of this period is a function of the heat detection rate as well as whether or not some hormonal regimen is used to bring cows into oestrus after the end of elective-waiting period (Peters, 1999).

The active breeding period is the third component and represents the number of days required for the cow to conceive after the first service (Peters, 1999). If a cow conceives at the first service, then the third component is nonexistent. Otherwise, this component is a function of the heat detection rate and the level of herd fertility. The level of herd fertility depends on several factors, including sire and cow fertility (Peters, 1999), the correct thawing and handling of semen, breeding technique, and timing of insemination (Peters, 1999). Establishing a pregnancy in a timely fashion depends on heat detection rate and herd fertility (Peters, 1999).

1.3: Factors influencing postpartum reproductive performance in retained placenta dairy cows:

1.3.1: Effect of parity and age:

In Zebu cattle, calving interval is longest in first-calf heifers and older cows, and shortest in cows of intermediate age between 6-9 years of age (Plasse et al., 1972). Plasse et al., (1972) also reported that a maximum calving interval was 496 days in 12 to 16 years cows, with similar values for young cows 3-6 years. Calving interval was shortest 424 days in cows of intermediate age 6-9 years. Earlier, Plasse et al., (1968) had also observed a tendency for calving intervals to shorten with increasing age in Brahman cows, as did Hinojosa et al., (1980) in a commercial Zebu herd in Mexico.

Montoni et al., (1981) found that calving interval was longest between the first and second calving, and shortest between the fifth and sixth calvings. Velarde et al ., (1975), working with Brahman cattle in Costa Rica, also found the longest calving interval between the first and second calving, and the shortest between the fourth and fifth calvings. These observations were consistent with those of Miranda et al., (1982b), working with Nellore cattle in Brazil, Baliero et al., (1981b), who studied Guzerat cows, and Dhoke and Johar (1977), working on Haryana cows in India. The last authors found that calving interval continued to shorten until after the sixth parity. This was also observed by Kumar and Bhat (1979), Ram and Balaine (1979), Oyedipe et al., (1982), Duarte et al., (1983); Singh et al., (1983).

De Vaccaro et al., (1977) noted that the first calving interval was considerably longer than the second or third interval in Nellore cattle in Peru, where only 14.5 % of the intervals lasted less than 400 days (13.3 months) and 49.5 % exceeded 601 days (20.0 months).

Saeed et al., (1987) found that year of birth significantly ($P<0.001$) affected age at first calving in Kenana cattle in Sudan but that month of birth did not. El-Khidir et al., (1979), working in Sudan, also found that, improved nutrition significantly decreased age at first oestrus ($P<0.001$), which in turn reduced age at sexual maturity, first conception, calving and total rearing costs.

Ahmad and Ahmad (1974) found that late first calving was associated with longer first dry periods ($r = 0.29$) and longer calving intervals ($r = 0.36$). Basu et al., (1979) observed that the number of services per conception increased with increasing age at first calving. Most data thus suggest that it is advantageous to breed heifers as early as is physiologically possible.

Analysing data from Botswana, Buck et al., (1976) found that fertility rate increased from 69 % in 2.5 years cows to a maximum of 82 % in 6 to 7 years old cows and then declined. In Bolivia, Plasse et al., (1975) also recorded an increase in pregnancy rate from 50 % in 3 years purebred Criollo and Criollo x Zebu cross breds to 75 % in 7 years cows. Fertility then declined to 50 % among 12 years cows. Causes of these age related differences include lactational stress in young growing animals and the ability of older cows to gain body weight and condition quickly after calving. Three years old lactating animals also showed a 10.9 % lower pregnancy rate than older lactating cows ($P<0.01$), which suggests that lactation has a greater effect on postpartum anoestrus in young primiparous animals than in older cows. Bastidas et al., (1984) confirmed this in Brahman first-calf cows, continuous suckling significantly reduced pregnancy rate compared to suckling twice daily (46.3±0.08 vs 79.8±0.08 %).

1.3.2: Effect of breed:

One of the few studies reporting extensively on the effect of breed on fertility in Africa was undertaken by Thorpe and Cruickshank (1980) in Zambia. They found that conception rate averaging 82.5, 78.1 and 75.4 % among 675 Angoni, 731 Barotse and 815 Boran cows, respectively, was significantly affected by year but not sire breed, although conception rate was higher in Angoni and Barotse cows when mated to bulls of their own breed. Evidence for dam breeds was also not conclusive. Among the Barotse, dry heifers had higher conception rates than lactating cows, whereas lactating Angoni and Boran cows had higher conception rates than dry cows. Perhaps the most significant observation among the Angoni and Barotse, but not the Boran, was that, cows calved early in the calving season were more likely to conceive during the following mating season than cows that calved late. This was consistent with observations by Trail et al., (1971) on Ankole and Boran cows in Uganda, and by Buck et al., (1976) on Zebu cattle in Botswana.

Borsotti et al., (1976) observed that genotype had a significant effect on the calving interval of Brahman cows in Venezuela. In Mexico, Valesio (1983) found calving intervals of 18.1 months for Gir and Indu-Brazil cattle, 18.8 months for Brown Swiss x Zebu crosses and 20.3 months for pure Brown Swiss cattle. The long calving interval of the Brown Swiss probably reflects lack of adaptation to the humid environment.

Nodot et al., (1981) reported that calving interval was affected by maternal grand sire. However, Duarte et al., (1983) found no significant effect of genetic grouping (proportion of Zebu blood) among cows in Brazil.

Estimates of the repeatability of calving interval range from near zero to 0.37. The heritability values obtained by Parmar and Johar (1982) in Tharparkar cows in India was 0.68±0.14, and by Weitze (1984) among Nellore cows in Brazil, was 0.81 to 0.86 appear to be exceptionally high.

1.3.3: Effects of body condition score:

Thorpe and Cruickshank (1980) observed that, Barotse, Angoni and Boran cows that calved were marginally heavier at the beginning and end of the breeding season than cows that did not calve. This was consistent with the findings of Buck et al., (1976); Buck and Light (1982) in Africander, Tswana and Tuli cattle and De Vaccaro et al., (1977) in Nellore cattle. The last authors calculated that heifers calving at the first and second opportunity averaged 272±33 kg live weight, compared with 262±27 kg ($P<0.01$) for those failing to calve. Ward and Tiffin (1975) also found that Mashona cows that weighed 318-364 kg at mating had a calving rate of 87.5 %, compared with 45 % for cows weighing 237-273 kg. Thus emphasized the importance of cow body weight at time of breeding:

In Zimbabwe, Richardson et al., (1975) found that a cow's ability to reconceive was a function of its final change in body weight at mating time, but was not related to its rate of body weight change from calving to midway through the mating season

In Botswana, Buck et al., (1976) found average conception rates of 50 % for cows weighing less than 300 kg at the beginning of the breeding season, 85 % for cows weighing 430 kg, 67 % for cows that lost weight over the breeding period and 76 % for cows that gained 20 kg weight over this period. Conception and pregnancy rates influenced positively by body condition and plasma concentration of progesterone at day 65 postpartum (Moreira et al., 2000).

1.3.4: Effects of season:

Thorpe and Cruickshank (1980) attributed the significant effect of year on calving rate to differences between years in the quantity and quality of forage available. Bishop (1978) found that calving percentage of Africander cross bred cows in South Africa was positively correlated ($r = 0.84$, $P<0.05$) with rainfall in the previous year. Jochle (1972) also found direct linear correlations between conception rate in Brahman cows and precipitation, pressure and temperature.

1.3.5: Effects of nutrition:

The reproductive performance of the postpartum cow is related to nutritional status (Dunn et al., 1969; Van Niekerk, 1982). Cows fed a high energy diet after calving conceives sooner than those with a lower energy intake (Wiltbank et al., 1962-1964; Dunn et al., 1969; Hill et al., 1970). Although protein is generally regarded as less important than energy for reproduction, low protein intake can also cause infertility. However, it may be difficult to differentiate the effects of low protein intake from concurrent low energy intake, because protein deficiency usually leads to decreased appetite (Hill et al., 1970).

Cattle in the tropics are usually dependent on natural pastures and crop by-products for feed. The crude protein content of the feed is often below 7.5%, which reduces rumen efficiency and reduces the true digestibility of the feed (Ward, 1968). As a result, lactating cows are unable to meet their nutritional requirements and lose weight and condition during lactation. This prolongs the lactational anoestrous period, and cows tend to calve in alternate years (Ward, 1968). The percentage change in the cow's body weight during the first 2 weeks after calving is inversely related to the number of days to first ovulation (Stevenson and Britt, 1980; Butler et al., 1981).

High levels of feeding before calving reduced the postpartum anoestrous period in Taurine cows (Bellows and Short, 1978). In addition, more cows exhibited oestrus before the breeding season and subsequent pregnancy rates were increased. King (1968) estimated that a 1% change in body weight resulted in a 1% change in first service conception rate.

In Zambia, feeding Zebu cows a sub-maintenance diet resulted in 55% of the animals stopping cycling within a year, whereas those on a maintenance diet continued to cycle normally (Rakha and Igboeli, 1971). The cows on the sub-maintenance diet also had a higher incidence of silent heats than the maintenance-fed cows. Two out of three oestrous cycles may be silent in underfed animals (Hale, 1974).

The growth and development of the foetus, parturition, lactation and involution of the uterus, all use energy (Olivares et al., 1981). The energy used by these processes must be supplied to the cow if she is to rebreed soon after calving. Generally, the farmer will not be able to meet the cow's whole energy needs, and some will be met from body reserves or fat. Thus a cow in good condition is better able to meet the energy requirements of parturition, lactation and involution of the uterus, and will therefore rebreed sooner, than a cow in poor condition. Cows should be well fed for 22-55 days before parturition and, if possible, for 90 days after parturition (Olivares et al., 1981).

Hale (1975) found that underfed dry Zebu cows stopped cycling when their weight fell to 320 kg from 390 kg. However, when the cows regained weight, they did not start cycling again until they were significantly heavier than the weight at which they stopped cycling.

Mukasa et al., (1989) estimated that traditionally raised Zebu cattle in the Ethiopian highlands needed 8 months after they stopped lactating to attain a body weight and condition that allowed them to reconceive successfully. The average calving interval was 26 months despite a lactation length of only 8 months. Fertility of grazing cows is therefore closely related to the live weight change during the calving-to service interval. The animal is likely to become sexually active only after it has regained much of its pre-calving weight.

McClure (1968) found that cows with a blood glucose concentration of less than 30 mg glucose per 100 ml blood tended to return to service. Cows must, therefore, be on an adequate or rising plane of nutrition and gaining mass during the mating season if conception is to be successful (Van Niekerk, 1982).

1.4: Retained placenta:

The retention of the foetal membranes is defined as the failure to expel the foetal membranes within 12 to 24 hours after calving (Fourichon et al., 2000). Condition of retained placenta occurs in 4 to 18 percent of calvings (Esslemont and Kossaibati, 1996). Primary retention of the placenta results from a lack of detachment from the maternal caruncles, whereas secondary retention (far less than the primary retention) is related to a mechanical difficulty in expelling already detached foetal membranes as in loss of uterine tone (Eiler, 1997).

In majority of cows the foetal membranes are shed by 6 hours and in a few cows after 12 hours postpartum. Many factors have been implicated with the incidence of retained placenta. An epidemiological study in Sweden revealed that, there is an increased risk associated with breed, increasing age, parturient paresis, dystocia, twinning, and male calves (Bendixen et al., 1987).

The incidence of retained placenta was lower in loose-housed cows than in tied zero grazing cows, suggesting the importance of exercise (Roberts, 1986). A previous history of retained placenta increased the risk in second, third, and fourth calving for certain breeds. Delayed shedding had detrimental effects on reproductive performance, milk production, postpartum disease and culling rate. It has been estimated that $154 million is spent on treating cows for this condition in the United States and is approximately $244 for each affected cow (Eiler, 1997). Incidence of metritis is 20 % higher in the case of retained placenta. It has been suggested that metritis, which accompanies retained placenta, results from the presence of decomposing placental tissues that provide a favorable environment for bacterial colonization. There is also a possible link between retained placenta and mastitis (Peters, 1999).

1.4.1: Aetiology:

Many direct and indirect factors could be considered as possible causes of retained placenta (Manspeaker, 2004).

1.4.1.1: Direct causes:

Retention of the foetal membranes comprises a lack of dehiscence and a failure of expulsion of the after birth within the duration of physiological third stage labour. It implies either an insufficiency of uterine contraction after the second stage of labour or a placental lesion which affects the normal physical union between the foetal villi and maternal crypts (Arthur et al., 1998).

1.4.1.2: Indirect causes:

Indirect causes are extremely variable and can be grouped in three broad categories:

1: Management problems:

I: Hygienic:

Cows are calved in the same barn and in many instances in the same calving stalls or maternity pens in frequent succession have been affected with retained placenta. Thus severe enzootic out breaks of retained placentae and secondary metritis were due to certain highly virulent organisms of Streptococcus dysgalactia, E.coli, Staphylococcus species which considered contagious from cow to cow (Wallace, 2005), Pseudomonas aeruginosa, Clostodium pyogens and other organisms which developed in these barns or calving stalls infecting the genital tracts of the parturient cows at the time of calving and causing acute metritis, retained placenta and secondary placentitis and metritis (Roberts, 1971) .

П: Heat intensive stress:

Heat can reduce gestation length and increase the incidence of retention of afterbirth in dairy cattle (Arthur et al., 1998). Thus Dubois and William (1980) found that cows which calved during warm season had reduction of 2.82 days in gestation lengths for retaining cows were, on average, 5.25 shorter than those of non retaining cows.

Ш: Nutritional deficiencies or imbalances:

There is evidence of high incidence of retained foetal membranes in areas deficient of selenium in diet (Trinder et al., 1969-1973; Julien et al., 1976). It is concluded therefore that selenium may be cause of endemic of retained placenta in certain areas.

There are clinical facts of an association between retention and parturient hypocalcaemia in Scandinavian herds (Roine and Saloniemi, 1978), both linked to linolenic acid rich diets (Chassagne and Barnouin, 1991).

Blom et al., (1984) reported that over supplementation of vitamin E increases rate of retained placenta.

Deficiency of vitamin A or its precursor (β carotene) increase rate of retained placenta cases (Ronning et al., 1953).

Moberg (1961) found that Iodine deficiency predisposes to stillbirth and retained placenta.

General nutrition factors linked to the condition from increased by product use to low Magnesium, Copper, Zinc and Iron lead to foetal membrane retention (Grunert, 1986; Zhang et al., 1992).

2: Shortened or prolonged pregnancy:

Factors associated with retained placenta cases (Muller and Owens, 1974) include:

I: Premature parturient (shortened pregnancy):

Premature birth, irrespective of its cause, is a common factor in many cases of retained of placenta (Arthur et al., 1998).

a) Abortion:

It is true that abortions in late gestation caused by Brucella abortus are likely to be followed by retention of placenta (Arthur et al., 1998), and incidence will be greater if happens after 120 days abortive foetus (Roberts, 1986).

b) Twins:

Morison and Erb (1957) stated that 43 % of cattle twin births were followed by retention, while Erb et al., (1958) reported that 37.4 % cases of retention were associated with twin births and abortions.

c) Elective caesarian section:

Removal of calf, prematurely, by caesarean operation delays the expulsion of the afterbirth. Premature birth whether induced by natural causes or surgically or pharmacologically implies either a failure of, or interference with, the endocrine control of parturition in which myometrial dysfunction is to be expected and consequently there will be failure to expel the placenta (Arthur et al., 1998).

d) Hormonal change:

Different types of abnormal changes in progesterone levels namely abrupt decreases or very slow decreases were accompanied by retained placenta (Chew et al., 1978). It was known that Prostaglandin $F_{2}\alpha$ ($PGF_{2}\alpha$) caused a precipitous drop in progesterone levels even some studies found the ratio of ($PGF_{2}\alpha$) to (PGE_{2}) in the uterine vein was higher in the cows developed retained placenta (Laven and Peters, 1996).

П: Prolonged pregnancy:

With less severe impairment of endocrine control the length of gestation will be normally governed and parturition will begin but not proceed normally. In the monotocous cow, failure of parturition beyond the second stage leads to retained placenta, also after full term pregnancy retained placenta are largely due to uterine inertia (Benesch, 1930; Jordan, 1952).

Endocrine cases depend on quantitative disorders of the normal preparturient hormonal ratios, particularly oestrogen and progesterone or on a synchrony of endocrine events or on temporal faults in the sequence of endocrine changes that precede parturition (Arthur et al., 1998).

1.4.1.3: Miscellaneous causes:

a) Breed:

Erb and Martin (1978) reported that breed has strong influence on retained placenta occurrence in particular Ayrshires breed which are more susceptible.

b) Age:

As Erb and Martin (1958) reported, retained placenta rates increase with age, which apparently observed in old cows.

c) Dystocia and Monsters:

Vandeplassche and Martens (1961) reported that incidence of dystocia and monsters cases up to 55 % were associated with retained placenta.

d) Trauma and placentitis:

Continual pressure on the caruncles and cotyledons usually results in retention of foetal membranes besides proliferative placentitis caused by Brucella abortus. (Arthur et al., 1998).

e) Season's changes:

Summer temperatures increase rate of retained placenta (Dubois and Williams, 1980). Highest incidence in spring was reported by Wetherill (1965).

f) Heredity:

Distl et al., (1991) reported that heredity had low evidence but not insignificant role on retained placenta incidence.

g) Fatty liver:

Fatty liver plays a role as if predisposes to uterine atony and retained placenta (Morrow et al., 1979).

1.4.2: Uterine infections:

Even without placental retention, the uterus at calving is susceptible to microbial invasion. The uterus of the cow continues to contract strongly for 48 hours following delivery of the calf. During this time, the cow usually sheds the placenta and evacuates the majority of uterine lochia (Garverick et al., 1993).

Abnormalities of involution cannot be diagnosed by palpation per rectum during the first week after calving. During that time, both normal and abnormal uteri are out of the examiner's hand reach and he or she cannot safely retract the uterus. By 10 to 15 days after calving, the examiner can palpate the entire uterus if involution is normal. Fluid should not usually be palpable within the lumen of the uterus by 14 to 18 days after calving if involution is normal. Gross reduction in size and histologic repair of the endometrium are complete in dairy cows by 40 to 50 days after calving (Morrow, 1966).

For the first two weeks after calving, cows normally expel lochia, which may range in colour from dark red or brown to white. If involution is delayed, discharge of lochia may continue until 30 days postpartum. The producer shouldn't consider the discharge of lochia abnormal unless the fluid is fetid and continues to be discharged for longer than 30 days or the cow develops other clinical signs (Garverick et al., 1993).

Some cows develop uterine infections. Many factors influence the severity and prevalence of uterine infections in cows. They include the species and pathogenicity of the causative organism, defenses and dietary management of the affected animal, and environmental sanitation (Cairoli et al., 1993).

Bacteria contaminate the uterus of all cows during parturition. Most of the organisms are merely transient residents of the reproductive tract and the involuting uterus in normal cows eliminates them (Cairoli et al., 1993).

In cows that develop uterine disease, Clostridium species occasionally colonizes the anaerobic postpartum uterus, causing severe toxic metritis. Other species of bacteria may be found in the uterus, but they have little effect on fertility. These organisms may, however, produce penicillinase (an enzyme that inactivates penicillin) and influence the choice and route of administration of drugs used in treating uterine infections (Roberts, 1971).

White blood cells (neutrophils) normally remove bacteria from the uterus. The ability of white blood cells to remove bacteria is depressed by an abnormal delivery (dead foetus or difficult birth), trauma to the uterus by obstetric manipulations or attempts to remove retained placenta and by some antiseptics and antibiotics (Garverick et al., 1993).

Uterine infections range from mild to severe depending upon the disease-producing ability of the invading microorganisms. Less severe cases are characterized by delayed uterine involution and impaired fertility. More severe cases (toxic metritis) are life threatening and are characterized by fever, depression, decreased milk production and lack of appetite. Pyometra is characterized by the accumulation of fluid within the uterus and persistence of a corpus luteum. The uterus is brought under the influence of progesterone, which further depresses phagocytic activity. Cows affected with pyometra seldom display any clinical signs other than failure to have oestrous cycles. Fluid from the infected uterus may ascend into the uterine tubes (oviducts), causing severe damage and reducing fertility. Frequently, abnormalities of the uterine tubes are not detected by palpation per rectum. Researchers have advocated a number of hormones, antibiotics and antiseptics for treatment of uterine infections in cows. Unfortunately, many of the recommendations have been based on uncontrolled observations (Garverick et al., 1993).

1.4.3: Metritis-pyometra complex:

Postpartum infection of the uterus has long been considered to be the predominant cause of bovine infertility (Drillich, 2006). However, its importance seems to vary greatly. For example, endometritis caused by Corynebacterium pyogenes, the principal bacterial cause of the disease occurs in up to 10 % of housed cattle but in less than 1% of many pastured herds. Retained placenta and twinning are conducive to the development of traumatic vaginitis and metritis. Both diseases have a deleterious effect on subsequent fertility.

Despite the cause, it is customary to recommend that endometritis be treated as early as and intensively as possible if the days open is to be kept short (Callahan and Horstman, 1987). This is probably a correct view within a cattle population that is adequately fed. There is also evidence that a single treatment of endometritis in a cow on about the 14th day after parturition is unlikely to have effect on the subsequent health of the uterus (Callahan and Horstman, 1987). Repeated rectal examinations can rule out the presence of uterine infection. In certain cases the infection may occur later than earlier. For example, occasionally uterine margins may feel thicker than its center after day 40 postpartum (Callahan and Horstman, 1987). The uterus in such cases is probably infected, even though it feels relatively small. Purulent exudates are probably still present in the uterus even though it is not discernible by rectal palpation. An ultrasonographic examination may be beneficial in diagnosis (Peters et al., 1992; Rajamahendran et al., 1994).

These cases can delay the open period considerably by delaying the occurrence of first fertile heat. In certain cases regardless of the time of postpartum, the prolonged uterine infection may lead to the collection of pus within the uterus due to the growth of pus producing organisms (Callahan and Horstman, 1987). A suitable antibiotic infusion with or without ($PGF_{2\alpha}$) treatment is recommended. This hormone is proved to be beneficial (Callahan and Horstman, 1987).

1.4.4: Diagnosis and clinical features:

Diagnosis is usually straightforward as degenerating, discolored, ultimately fetid membranes are seen hanging from the vulva more than 24 hours after parturition. Occasionally, the retained membranes may remain within the uterus and not be readily apparent, in which case their presence may be signaled by a foul-smelling discharge (Merck et al., 2006). In most cases, there are no signs of systemic illness. When systemic signs are observed, they are related to toxaemia. Uncomplicated retention of foetal membranes is unsightly and inconvenient for animal handlers and milkers but generally not directly harmful to the cow. However, cows with retained foetal membranes are at increased risk of developing metritis, ketosis, mastitis, and even abortion in a subsequent pregnancy (Merck et al., 2006). Cows that have once had retained foetal membranes are at increased risk of recurrence at a subsequent parturition (Merck et al., 2006).

The duration of retention seems to depend on several factors such as the extent of the areas of attachment of the foetal membrane, the rate of uterine involution, the amount of the uterine exudates and the proportion of the afterbirth which had already passed through cervix when retention began. In addition experienced clinician can detect differences in texture of the retained foetal cotyledons in cattle which have prognostic significance, where they are fleshy and large, they detach more readily than when they are thin and stringy, in which cases they appear to be adherent to the maternal caruncles (Arthur et al., 1998).

1.4.5: Treatment:

I: No treatment:

On the grounds of health of the retention case during the puerperium and with respect to its future fertility uncomplicated cases required no treatment. It requires courage to prescribe no treatment and it would be impudent to adopt a rigid of noninterference (Arthur et al., 1998).

П: Manual extraction:

In the commonest methods of treatment for retained placenta, the techniques vary from unpicking to traction. It is extremely effective and simple method which has been used for a long time (Scipio, 1889).

An ideal practice would be to carry out a careful aseptic exploration of the uterus of the affected cow within one day of parturition and to remove the membranes if the foetal cotyledons can be completely detached without injury to the maternal caruncles. If it is found impracticable to remove them on the first occasion the examination may be repeated. However it is frequently found that attempts at removal during the first 48 hours are unsuccessful for the placenta is then firmly attached in addition to the apical parts of the gravid horns for these reasons it has become a common practice to delay interference until day three or four. By this time the progress of putrefactive liquefaction in the foetal component of the cotyledons makes their separation much easier to accomplish while the degree of uterine involution which has occurred brings the apex of cornu, where the attachments are most firm, within reach (Arthur et al., 1998).

Cases vary in the relative ease of their treatment from those in which the whole mass of after birth is found free in the uterus to others in which not even the most caudal cotyledons can be separated and for which further treatment required (Arthur et al., 1998). Pessaries containing antibiotics may be placed in the uterus and parenteral injection of a long acting antibiotic given. If the cow is ill with toxaemia, further daily exudates drainage must be applied (Arthur et al., 1998).

Most contemporary authors agree that manual removal of the placenta is indicated only when it may be removed by gentle traction, indicating that most or all placentomes have separated (Roberts, 1971). Manual removal is specifically contraindicated when the patient shows any sign of systemic illness (septicemia) (Roberts, 1971). Unfortunately, many dairy producers are accustomed by tradition to manual removal and may insist on attempting the procedure for the sake of the patient's health and future fertility (Roberts, 1971). The therapy of retained foetal membranes in cattle has been a controversial subject for many years. Manual removal and an intrauterine antibiotic treatment are common in veterinary practice in Europe (Laven, 1995) and, to a lesser extent, in the United States and Canada.

Ш: Therapeutic treatments:

1::Antibiotics:

Reports concerning the results of treatment of retained placenta are conflicting. In one trial, reproductive performance of cows with retained placenta treated with intrauterine Tetracycline was found to be similar to that of unaffected herdmates and better than that of affected cows that were examined vaginally (laven and Peters, 1996). Others have found that treatment with Tetracycline reduced subsequent fertility and that normal conception rates could be expected if no medication were given. Routine treatment of cows that required assistance at delivery or had retained placentae with systemic and intrauterine antibiotics did not help prevent metritis. Pyometra may develop even in treated cows.

The most reasonable antibiotic treatment (when indicated) for uterine infections is intrauterine administration of Oxytetracycline or systemic administration of

Penicillin during the early postpartum period and intrauterine or systemic administration of penicillin after 30 days postpartum. Treatment of dairy cows with antibiotics results in residues in the milk from treated animals (Garverick et al., 1993).

Intramuscular administration of Oxytetracycline (10 mg/kg) on days 11 to 14 (after shedding of the foetal membranes) led to a shorter period of uterine infection compared with other retained foetal membrane cows (Konigsson, 2001).

Oxytetracycline treatments on days 3 to 6 (before shedding of the foetal membranes) had no effect on the length of the uterine infection, but seemed clinically beneficial for the cows. However, treatment at this time led to a delayed placental shedding and an alteration of the postpartal ($PGF_{2}\alpha$) metabolite profile (Konigsson, 2001).

2: Hormones:

a) Oxytocin:

Hormones have been widely used in the treatment of retained placenta the use of Pituitrin or Oxytocin has been mentioned as being of possible value in preventing retained placenta, when given shortly after the expulsion of the foetus or dystocia or operation in dystocia, besides aiding in the expulsion of the foetal membrane Pituitrin may prevent uterine prolapses (Roberts, 1971). Several authors have suggested that Oxytocin administered within the first 24 to 48 hours after calving may be beneficial in promoting expulsion of the placenta. More recent work, however, has shown that treatment with a single dose of Oxytocin does not reduce the incidence of retained placenta in cows that calve normally nor in cows that require assistance at calving (Garverick et al., 1993).

b) Oestrogenic substances:

Oestradiol and synthetic Stilboestrol have been widely used in the treatment of retained placenta they were thought to have beneficial effect in two ways increasing the sensitivity of uterine muscles to Oxytocin and support the anti-infective properties of the endometrium (Arthur et al., 1998). Treatment with an oestrogenic hormone immediately after calving may decrease fertility in cows with retained placentas (Garverick et al., 1993).

c) Prostaglandin:

The use of Prostaglandin can be a valuable tool in dairy programs. It does not replace the need for excellent reproductive management and active veterinary involvement. Variable results have been observed when Prostaglandins are used in dairy cows between 14 and 28 days postpartum, measured by the impact on subsequent fertility and days open (Radostits et al., 1994). A single or double injection of ($PGF2\alpha$) during postpartum period at 10 to 14 days interval was reported to decrease the number of days open (Youngquist, 1988). It may be that a positive impact is seen only in herds whose reproductive efficiency is poor to begin with, not in generally well managed herds. It has been well established that this compound has a positive potential action in the presence of an active corpus luteum on the ovary. Its uterotonic action helps to expel the uterine content in suspected cases of metritis / endometritis. Use of ($PGF2\alpha$) has generally been found profitable; however, the indiscriminate use of Prostaglandin should be discouraged (Murugavel et al., 2003). In herds with higher incidence of postpartum metritis complex, use of Prostaglandin either on day 26 or day 40 may increase reproductive performance (Etherington et al., 1988). Treatment on day 8 postpartum to cows that did not have assisted calving reduced the occurrence of first oestrus from 40 to 37 days and increased the interval from calving to conception from 83 days to 85 days (White and Dobson, 1990). In cows that required assistance at calving, the treatment reduced the mean interval between calving and first heat from 44 to 34 days and reduced the mean calving to conception interval from 86 days to 68 days (White and Dobson, 1990). Two treatments (25 to 32 days and 39 to 46 days postpartum) increased pregnancy by 10 % (Pankowski et al., 1995). Treatment on day 21 postpartum reduced the interval to first oestrus and service by 10 days (Schofield et al., 1999). Treatment on day 21 postpartum to cows that had complicated parturition reduced the incidence of puerperal endometritis. No improvement in conception rate in cows with complicated and uncomplicated parturition was also reported by Michiel et al., (1999). Response to ($PGF_{2}\alpha$) may depend on time, interval between administrations, and postpartum conditions (Kristula and Bartholomew, 1998). ($PGF_{2}\alpha$) is the treatment of choice for bovine pyometra. Treatment is followed in three to nine days by uterine evacuation in 85 to 90 percent of treated cows. In cases of chronic metritis, treatment with ($PGF_{2}\alpha$) decreases the number of days open (Le Blanc et al., 2002).

The highest levels of the ($PGF_{2}\alpha$) metabolite were found during the foetal expulsion.

In cows without retained foetal membranes, levels decline after parturition. In cows with retained foetal membranes however, this decline is changed into increasing levels within a few hours after expulsion of the foetus (Konigsson, 2001).

d) Gonadotropin-releasing hormone:

Treatment of cows with Gonadotropin-releasing hormone (GnRH) at two weeks after calving may improve fertility and led to shorter calving to conception interval (Bosu et al., 1988), but treatment with GnRH at the time of manual removing may decrease fertility by increasing cases of pyometra in herds with a high incidence of uterine infections (Etherington et al., 1984).

3: Uterine washing:

Wide range antiseptics have been used locally in treatment of retained placenta and uterus such as Boric acid, Acriflavin, Iodine, Potassium permanganate and Lotagen to control the bacterial flora after placental removal (Roberts, 1971). Antiseptics can be used in a wide range of situations on account of several mechanisms of action, with different strains of bacteria and fungi. Accordingly, the antiseptics have been most commonly administered via the uterus their main effect may be to reduce putrifiction, which would reduce odour (Roberts, 1986).

4: Administration of Calcium borogluconate:

Uterine inertia due to hypocalcaemia obtained benefits in some cases of retained placenta by administration of calcium gluconate (Arthur et al., 1998).

1.4.6: The effect of retained placenta:

1: Reduction in milk production:

55-65 percent of cows with retained placenta have a reduced appetite (Arthur et al., 1998), which causes a reduction in milk production. Loss in yield is said to be more pronounced in the 20 to 25 percent of the cases that exhibit moderate to severe symptoms of metritis (Roberts, 1986), though this extra loss is probably less than that due to the retained placenta alone (Simerl et al., 1992).

2: Reduction in fertility:

The consequences of retained placenta include an increase in calving to first services interval, a reduction in pregnancy rate to first services, an increase in the number of services per conception and consequently a longer calving interval (Fung, 1983; Halpern et al., 1985; Heinonen, 1989).

Reduction in fertility occurs in two ways, first by direct effect through an unknown mechanism and secondly by an indirect effect as a major component in the pathogenesis of metritis which is usually associated with a deleterious effect on fertility (Mellado and Reys, 1994). The results of the evaluated studies were heterogeneous (Fourichon et al., 2000). The frequent occurrence of metritis after retained placenta was identified as the main reason for reduced fertility of cows (Laven and Peters, 1996; Gröhn et al., 2000).

I - Direct

The magnitude of this effect varies widely, Borsebrry and Doboson (1989); and Erb et al., (1981) found that uncomplicated retained placenta could lead to an increase in calving interval, however, other studies have shown no direct effect of the conditions on fertility (Sandals et al., 1979; Nakao et al., 1992).

Π- Indirect

There is very close association between retained placenta and the development of metritis, which may be up to 19 times more likely than after a normal calving (Curtis et al., (1985).This increase in metritis is thought to be the major route by which the condition affects fertility. However, Etherington et al., (1985) found improved fertility, a reduction in days to first services and days open after postpartum metritis associated with systemic signs.

Shanks et al., (1977) and Gwazduaskas et al., (1979) found lack of both direct and indirect effect on fertility. Such apparent contradictions occur because conception is a complex process and many factors could interact to increase or reduce fertility (Laven and Peters, 1996).

3- Other losses

Despite treatment retained placenta could lead to mortality rate of 4 percent (Arthur et al., 1998).

Chapter two

Material and Methods

2.1: Material

2.1.1: Location:

This study was conducted in Khartoum which is located between longitude from 15 ° 33¯ to 15 ° 78¯ North and latitude from 32° 32¯ to 32° 71¯ East and represents a typical semi-arid zone. Two different areas in East Nile region of Khartoum North were selected, The Military Farm and Ed Babikir where local milk producers are found.

2.1.2: Climatic conditions:

The area is semi-desert with substantial variation in temperature and humidity; in summer (March-June) monthly average temperature is ranging between 40.5 and 23.0 C º as the highest point of temperature, while in autumn (July-October) the range is between 38.7 and 24.5 C º, and the rain dominates the period where precipitation average reaches 26.08 millimeter with moderate temperature. In winter (November-February) the range is between 33.8 and 17.0 C º, the temperatures reach its minimum as the cold period of the year. The humidity degree varies with season, in winter reaches the average of 23 %, while in summer and autumn it records 22 % and 45 %, respectively.

2.1.3: Animals:

The 248 cross bred dairy cows and heifers between Northern Sudan local Zebu cows with Friesian blood percentages ranging between 50 to 99.9 percent were used. Animals have been monitored from calving to pregnancy.

These animals were raised in 16 farms in Khartoum. Each experimental animal had a complete and regular health records including diagnosis of diseases, type of treatment, reproductive performance such as heat detection, number of services and pregnancy diagnosis.

2.1.4: Housing:

Most animal houses were constructed from local materials such as wood and grass-woven mats, while some were built from iron poles and corrugated iron sheets. The East and West longitudinal axis gives all day shade in the majority of farms.

The pens were divided to suit production groups such as milking cows, dry cows, replacement heifers, and calves.

2.1.5: Management:

All cows have been identified by names, numbers and photographs. Previous case history was recorded.

Feed and water troughs were available in every pen. Sanitation procedures including manure removal were pursued. In all farms hand milking was used inside pens. However, some farms have milking parlours.

Retained placentae cows have been ranked into three groups and compared to those had calved normally within the same time. Dairy cows were milked for many months after calving till the next delivery approach, though, some farmers adopt fixed time for drying off cows. Diseased animals were treated individually.

2.1.6: Feeding system:

2. 1.6.1: Roughages:

Generally most of the animals were fed on green fodder consisted of sorghum grass (Abu 70) and Green Alfalfa (Barceem).

Sorghum straws, groundnut residues, bagas and molasses were used as alternative sources of roughage feed in summer because of green fodder scarcity.

2.1.6.2: Concentrates:

Different preparations of concentrates have been observed throughout the study. The actual amount of ration depended on level of milk production for every animal and usually ranged between 2 kg to 4 kg twice daily. The essential ingredients included crushed sorghum, groundnut cakes, and wheat bran besides mineral additives such as Sodium chloride and Calcium. The chemical analyses of each ingredient in the concentrate ration revealed the following:

Feed ingredients	Dry matter %	Fat %	Crude protein %	Fiber %	Ash %	Nitrogen free extract %
Sorghum crush/ Feterita	٩٤,٥	٢,٢٦	١٣,٢٣	٢,٤٨	٢,١٥	٧٤,١٣
Groundnut cake	٩٥,٤	٧,٩٦	٤٣,٥٨	٩,٧٢	٩,٢٥	٢٤,٨٩
Wheat bran	٩٣,٥	٣,٢٣	١٦,٨٣	١٢,٩٨	٥,٤٤	٤٨,٨٥

2.2: Experimental design:

This study began in July 2004 and continued till May 2006. Foetal membranes retention was diagnosed in 66 percent of 248 selected calved cows, whereas 34 percent of the observed cases had normally expelled placenta.

Animals have been divided into control and retained placentae groups, the later were divided into three subgroups according to the treatment applied. Cows were clinically examined 12 to 72 hours after calving. Parameters monitored included, cow number or name, temperature, respiratory rate, appetite, time of calving, age, number of calvings, body condition score, live body weight and estimation of foreign blood percentage.

All cases were treated manually from 48 hours to 72 hours after parturition associated with different therapeutic protocols. The degree of manual treatment had been divided into complete and incomplete extraction. The first type included 74.4 percent of cases compared with 25.6 percent for the second type.

2.2.1: Groups:

The study was carried out to compare postpartum reproductive performance between the control group and the three different treatment groups of cows with retained placentae, as well as between the later groups themselves.

I: Control group (C):

This group contained 84 cows that expelled their placentae after12 hours from parturition and were apparently healthy.

П: Retained placentae groups:

One hundred fifty four dairy cows failed to expel the foetal membranes for more than 12 hours to 72 hours after parturition. They had been divided into three groups:

a) Treatment group 1 (G1):

This group included total of 63 retained placentae dairy cows. Treatment applied consisted of manual extraction with insertion of intrauterine Tetracycline Hcl pessaries (Teline. East African Pharmaceuticals, Addis Ababa- Ethiopia), and intramuscular injection of Oxytetracycline (1ml/10kg) (Vetecycline, S. J and G, Fazul Ellahie, Karachi- Pakistan).

b) Treatment group 2 (G2):

This group consisted of 44 retained placentae dairy cows, treated as treatment group 1 (G1) besides an injection of 2ml Prostaglandin F2α (PGF2α) analogue, Cloprostenol sodium 250mcg/ml (Juramate, M/S Jurox, Australia) immediately 3 days after calving.

c) Treatment group 3 (G3):

This group was comprised of 40 retained placentae dairy cows treated as treatment group 1 (G1) in addition of using (PGF2α) two weeks after calving, the same dose as treatment group two.

2.3: Methods and procedures:

2.3.1: Manual extraction:

Retained placenta was removed by inserting the hand covered with plastic gloves between the endometrium and chorion in the intercotyledonary space and the individual foetal cotyledon and its caruncle, were grasped gently, squeezed and with thumb and forefinger. The two structures were separated by rolling, pushing and squeezing motion aided by traction with the other hand.

2.3.2: Rectal examination:

The technique had been used by inserting the gloved handed, aided by lubricant, into the rectum in the form of a cone. The hand was advanced far beyond the organ or structure to be palpated this was done once a week.

Rectal examination was used as follow up procedure for uterine involution, palpable ovarian structures such as graffian follicle and corpus luteum or for detection of pathological condition. Also rectal examination was used to detect pregnancy. In this study uterine size and contractility besides ovarian structures had been checked once a week and continued till the involution of the uterus and cervix was completed and ovarian cyclicity was resumed.

The comparative measurements of the uterine size comprised the subject of weekly rectal palpation. It was categorized into five degrees as follows (Krizanec, 2003):

1- First degree: The uterus located on the floor of the pelvic cavity and could be completely gathered in the hand, and the horns were strong as one finger in size.

2- Second degree: Similar as above, however, horns were strong as two to four fingers large.

3- Third degree: The uterus was located on the pelvic brim, the top surface of uterus could be felt.

4- Fourth degree: The uterus could hardly be contained within the hand it was large and could not be reached.

5- Fifth degree: The uterus was laid over the pelvic brim on the floor and could not be reached.

Detection of the first postpartum ovarian activity depends on presence of palpable corpus luteum.

2.3.3: Body weight recording:

Dalton's weight band was used to estimate body weight, the chest circumference was measured behind the wither and elbow while the animal was standing on a leveled ground. This was done once a week during this study.

2.3.4: Detection of heat:

The signs and degree of external manifestations of oestrus had been carefully observed especially during period of activity such as before and after milking and feeding that means four times a day. The cow considered on heat when it stands to be mounted by other cows, a clear vaginal mucous discharge hangs from its vulva and when it bellowed.

2.3.5: Number of services per conception:

Natural service has been the central approach to inseminate cows using mature and fertile bulls. Number of services on each cow along the postpartum period till pregnancy had been recorded carefully. Pregnancy diagnosis was performed after 60-90 days from last insemination then the number of services be calculated accurately.

2.3.6: Open period:

It has been evaluated as the average number of days from the most recent calving to conception.

2.3.7: Statistical analysis:

Statistical analyses were performed by modified SPSS (Statistical packages for social science) version 10.0 (2002). Means were computed and overall means compared by T-test, evaluated by two tailed analyses of variance (ANOVA), with a value of ($p< 0.05$) considered statistically significant.

Investigated animals were monitored for factors which relatively affected postpartum period. These factors included age, parity, body weight, foreign blood percentage, and season. Furthermore, their effects on postpartum reproductive traits have been studied separately.

All data are presented in tables from 1 to 38 in percentages or means ± standard deviations. Figures numbered from 1 to 25 represent the different links between variables in four different experimental groups.

2.3.8: Picture of retained placenta cow:

Notice. The retained foetal membranes hanging from the cow's vulva and the housing materials in Ed Babikir area- Khartoum.

Chapter three

Results

3.1: The effect of treatment groups (1), (2) and (3) on postpartum reproductive traits in cross bred dairy cows:

As shown in Table (1) the effect of treatment group varies relevant to the traits.

The uterine involution process hastens the shortest average period in the treatment group (2) with 22.65±8.04 days followed by group (3) and (1) with 23.19± 4.78 days and 25.12±7.25 days, respectively, while the control group attained 29.44 ±7.93 days.

The treatment groups (1), (2) and (3) revealed larger numbers of days to first ovarian activity with 47.46±22.07 days, 44.28±23.58 days and 42.46±21.96 days respectively, more than the control group which gained 38.27±13.54 days.

The occurrence of first observable oestrus illustrated that the treatment groups (3), (1) and (2), respectively, manifested the heat earlier than the control group with averages of 41.93±16.03 days, 45.16±20.34 days and 48.84±25.46 days, respectively, while the control group recorded 53.90±24.11 days.

The treatment effect on number of services per conception showed that groups (1) and (2) recorded 3.55±1.81 and 3.26±1.79, respectively, as highest numbers of services per conception, while the control group attained 3.05±2.13 lower than that and more than the treatment group (3) which attained 2.81±1.59.

The effect of treatment on open period showed slight difference between groups (1) and (2) from side and the control group from the other side with averages of 114.99±34.78 days, 114.51±28.33 days and 115.39±22.98 days, while treatment group (3) achieved the shortest period with 98.68±25.00 days.

Table 1. The effect of treatment groups (1), (2) and (3) on postpartum reproductive traits in cross bred dairy cows (X±STDEV)

Traits	Treatment groups				Overall Means
	C	G1	G2	G3	
Number of animals	n=84	n=63	n=44	n=40	n=231
Uterine involution process (days)	29.44 a ± 7.93	25.12 c ± 7.25	22.65 b ± 8.04	23.19 b ± 4.78	25.10 ± 7.00
First ovarian activity (day)	38.27 a ± 13.54	47.46 b ± 22.07	44.28 c ± 23.58	42.46 c ± 21.96	43.12 ± 20.29
Occurrence of the first observable oestrus (day)	53.90 a ± 24.11	45.16 b ± 20.34	48.84 c ± 25.46	41.93 a ± 16.03	47.46 ± 21.48
Number of services per conception	3.05 b ± 2.13	3.55 a ± 1.81	3.26 b ± 1.79	2.81 a ± 1.59	3.17 ± 1.83
Open period (days)	115.39 b ± ٢٢,٩٨	114.99 c ± ٣٤,٧٨	114.51c ± ٢٨,٣٣	98.68 a ± 25.00	110.89 ± 27.78

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a row indicates a statistically significant difference (P≤0.05).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

3.1.1: Postpartum reproductive traits

3.1.1.1: Uterine involution process:

As presented in Table (2) strong significant differences ($p<0.05$) were existed between the control group and the treatment groups, while no significant differences ($p<0.05$) were computed between the treatment groups. The over all average period achieved for complete uterine involution in the control group was 29.44±7.93 days, while the treatment groups (1), (2) and (3) recorded shorter period with 25.12±7.25 days, 22.65±8.04 days and 23.19±4.78 days, respectively.

3.1.1.2: First postpartum ovarian activity:

Table (3) revealed a strong significant difference ($p<0.05$) between the control group and treatment group (1). No other significant differences ($p<0.05$) were found. The first detected ovarian activity, as indicated by presence of corpus leutum, was at 38.27±13.54 days postpartum in the control group, while the treatment groups (1), (2) and (3) attained 47.46±22.07 days, 44.28±23.58 days and 42.46±21.96 days, respectively.

3.1.1.3: Occurrence of first observable postpartum oestrus:

Table (4) showed a strong significant difference ($p<0.05$) between the control group and treatment group (3), while a weak significant difference ($p<0.05$) was counted between the control group and treatment group (1). No other significant differences ($p<0.05$) were found between the other groups. The average period attained in the control group was 53.90±24.11 days, while the treatment groups (1), (2) and (3) took 45.16±20.34 days, 48.84±25.46 days and 41.93±16.03 days, respectively.

3.1.1.4: Number of services per conception:

Table 2. Factors influencing the uterine involution process (X±STDEV)

Treatment groups	Age	Parity	Body weight	Foreign blood percentages	Over all means
C n=84	28.60 ^{a} ± 8.60	29.54 ^{a} ± 8.80	29.00 ^{a} ± 8.61	30.63 ^{a} ± 5.71	29.44 ± 7.93
G1 n=63	24.50 ^{c} ± ٧,٠٥	25.41 ^{c} ± 7.14	25.14 ^{d} ± ٧,٠٨	25.41 ^{c} ± 7.72	25.12 ± 7.25
G2 n=44	24.50 ^{c} ± ٧,٠٥	21.80 ^{b} ± 8.30	22.30 ^{b} ± 8.40	22.00 ^{b} ± ٨,٤١	22.65 ± 8.04
G3 n=40	23.00 ^{b} ± ٤,٧٥	22.80 ^{b} ± 4.74	23.90 ^{c} ± 4.84	23.04 ^{b} ± 4.80	23.19 ± 4.78

(X±STDEV)- Data are means±standard deviation.
a, b, c and d different superscript letters within a column indicates a statistically significant difference (P≤0.05).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

Table 3. Factors influencing the first postpartum ovarian activity (X±STDEV)

Treatment groups	Age	Parity	Body weight	Foreign blood percentages	Over all means
C n=84	37.80 a ± 13.40	38.72 a ± 13.69	38.14 a ± 13.60	38.43 a ± 13.45	38.27 ± 13.54
G1 n=63	44.64 b ± 19.23	48.00 a ± 22.50	48.63 b ± 23.74	47.58 b ± 22.80	47.46 ± 22.07
G2 n=44	44.63 b ± ٢٤,٨٢	43.66 b ± 22.40	43.83 c ± 23.74	45.00 c ± 23.34	44.28 ± 23.58
G3 n=40	42.00 c ± 21.72	42.13 b ± 22.11	42.69 c ± 22.30	43.00 d ± 21.70	42.46 ± 21.96

(X±STDEV)- Data are means±standard deviation.
a, b, c and d different superscript letters within a column indicates a statistically significant difference (P≤0.05).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

Table 4. Factors influencing the occurrence of first observable postpartum oestrus

(X±STDEV)

Treatment groups	Age	Parity	Body weight	Foreign blood percentages	Over all means
C n=84	53.90 a ± 24.50	54.20 a ± 22.48	54 .00 a ± 26.00	53.50 a ± 23.45	53.90 ± 24.11
G1 n=63	42.55 b ± 18.07	46.12 b ± 21.00	44.60 b ± 21.24	47.38 b ± 21.04	45.16 ± 20.34
G2 n=44	49.19 c ± 26.45	48.60 b ± 25.60	49.81 b ± 25.78	47.76 c ± 24.00	48.84 ± 25.46
G3 n=40	42.00 b ± 16.32	41.82 a ± 16.64	41.50 a ± 15.10	42.40 a ± 16.05	41.93 ± 16.03

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

As shown in Table (5) there were no significant differences ($p<0.05$) between the four experimental groups except a weak significant difference ($p<0.05$) between the treatment groups (1) and (3). The control group attained 3.05±2.13 services per conception, while the treatment groups (1), (2) and (3) recorded 3.55±1.81, 3.26± 1.79 and 2.81±1.59, respectively.

3.1.1.5: Open period:

Table (6) showed strong significant differences ($p\leq0.05$) between the treatment group (3) and both the control group and treatment groups (1) and (2). No other significant differences ($p\leq0.05$) were found. The open period recorded for the control and treatment groups (1), (2) and (3) were 115.39±22.98 days, 114.99±34.78 days, 114.51±28.33 days and 98.68±25.00 days, respectively.

3.2: Factors influencing the postpartum reproductive traits in the control and treatment retained placentae groups cross bred dairy cows:

3.2.1: Effect of age:

Table (7) revealed that the incidence of retained placenta decreased with age in cross bred dairy cows. The highest incidence of cases recorded was at the age range of 2-4 years, while the lowest one at the age range of 5-6 years.

3.2.1.1: Effect of age on uterine involution process:

Figure (1) shows age effect on uterine potential return to its normal size. The longest averages period recorded for the control group and treatment groups (1), (2) and (3) were 32.1±11.3 days, 30.1±5.8 days, 30.3±10.7 days and 24.3±4.6 days, respectively, and that was at similar age range of 9-11 years.

The shortest period recorded in the control group and the treatment groups (1) and (2) were 25.8±7.1 days, 21.7±6.7 days and 20.3±8.5 days, respectively, at the

Table 5. Factors influencing the number of services per conception (X±STDEV)

Treatment groups	Age	Parity	Body weight	Foreign blood percentages	Over all means
C n=84	3.30 a ± 2.10	3.00 b ± 2.00	2.67 a ± 1.90	3.22 b ± 2.01	3.05 ± 2.00
G1 n=63	4.00 a ± 1.70	3.56 a ± 1.73	3.37 a ± 1.80	3.30 b ± 2.00	3.55 ± 1.81
G2 n=44	3.91 b ± 1.82	3.05 b ± 1.80	3.10 b ± 1.73	3.00 c ± 1.80	3.26 ± 1.79
G3 n=40	3.17 a ± 1.60	2.50 a ± 1.65	3.21 b ± 1.51	2.34 a ± 1.60	2.81 ± 1.59

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference ($P \leq 0.05$).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

Table 6. Factors influencing open period (X±STDEV)

Treatment groups	Age	Parity	Body weight	Foreign blood percentages	Over all means
C n=84	115.30 a ± 13.50	117.00 b ± 32.56	113.44 c ± 13.60	115.28 b ± 32.27	١١٥,٣٩ ± ٢٢,٩٨
G1 n=63	112.81 b ± 34.30	115.24 c ± 33.26	115.80 c ± 37.41	116.12 b ± 34.13	١١٤,٩٩ ± ٣٤,٧٨
G2 n=44	110.00 c ± 31.16	116.50 b ± 27.19	116.00 b ± 27.70	115.57 b ± 27.28	١١٤,٥١ ± ٢٨,٣٣
G3 n=40	97.23 a ± 25.50	97.85 a ± 26.67	101.40 a ± 21.00	98.23 a ± 26.82	٩٨,٦٨ ± 25.00

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).
n- Number of animals.
C- Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).

Table 7. Effect of age on incidence of retained placenta in cross bred dairy cows

Age range (Years)	Total cases observed	Retained placenta cases	
		Number of animals	Percentage
2-4	٧٩	٥١	٢٤ %
5-6	٤٢	٢٢	١٠ %
7-8	٥١	٣٦	17 %
9-11	٤٠	٢٨	13.2 %
Total	٢١٢	١٣٧	64.6 %

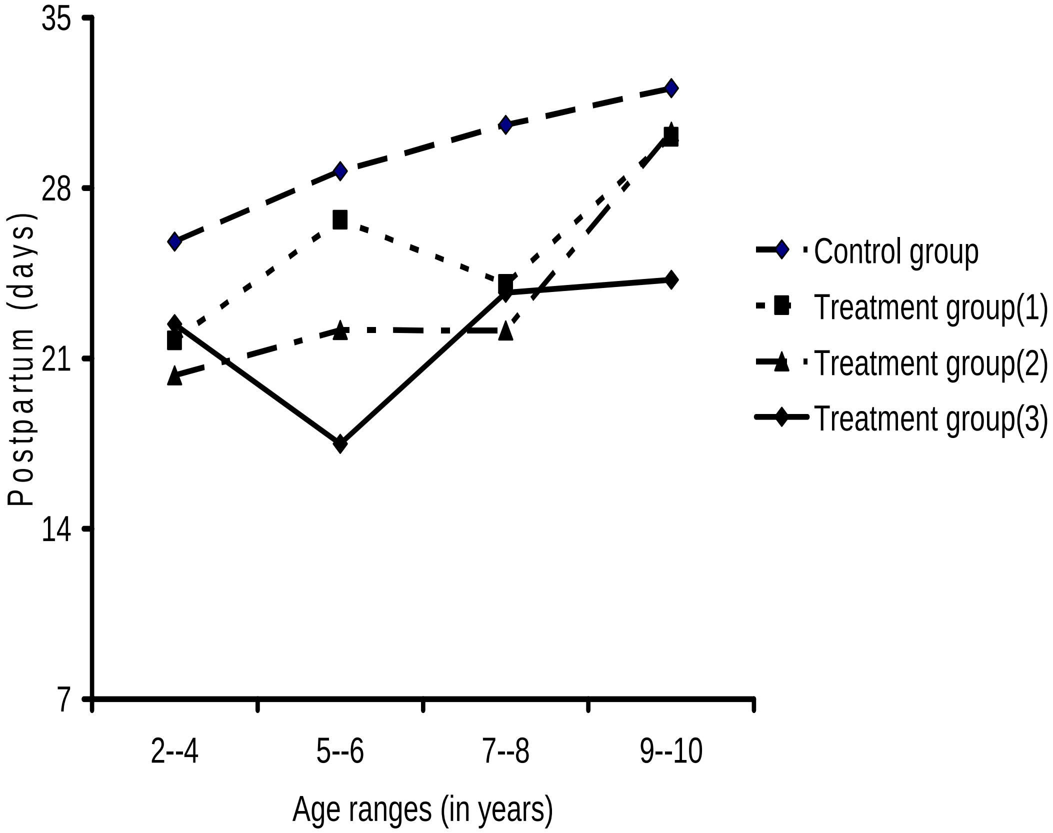

Figure 1. Effect of age on uterine involution period in the control group (C) and the treatment groups (1), (2) and (3) .

same age range of 2-4 years, while treatment group (3) recorded 17.5±4.0 days, at the age range of 5-6 years.

No significant differences ($p \leq 0.05$) were found between the treatment groups; however, there were strong significant differences ($p < 0.05$) between the control group and treatment groups (1), (2) and (3).

3.2.1.2: Effect of age on first postpartum ovarian activity:

As shown in Figure (2) the highest average recorded in the control group was at the age range of 9-11 years and this was similar to that of treatment groups (1), (2) and (3) with 42.2±21.3 days, 56.6±28.0 days, 59.3±24.3 days and 48.5±28.3 days, respectively.

On the other side the lowest average recorded in the control group was 34.8±7.4 days, at the age range of 7-8 years compared with 39.4±10.8 days, at the age range of 2-4 years in treatment group (1), whereas, treatment groups (2) and (3) attained 34.7±10.2 days and 31.3±6.9 days, at similar age range of 5-6 years.

There was a weak significant difference ($p < 0.05$) between the control group and the treatment group (1), while no significant differences ($p \leq 0.05$) were computed between the other groups.

3.2.1.3: Effect of age on occurrence of first postpartum oestrus:

Figure (3) revealed that the highest average observed in the control group was 59.1±23.0 days, at the age range of 5-6 years, while treatment group (2) recorded 51.8 ±29.6 days, at the age range of 2-4 years. Moreover, treatment groups (1) and (3) achieved 51.4±10.9 days and 49.2±18.0 days, respectively, at the age range of 9-11 years.

The shortest period recorded in both the control and the treatment groups (1) and (3) were at the age range of 2-4 years with averages of 50.6±23.2 days, 38.4±21.3

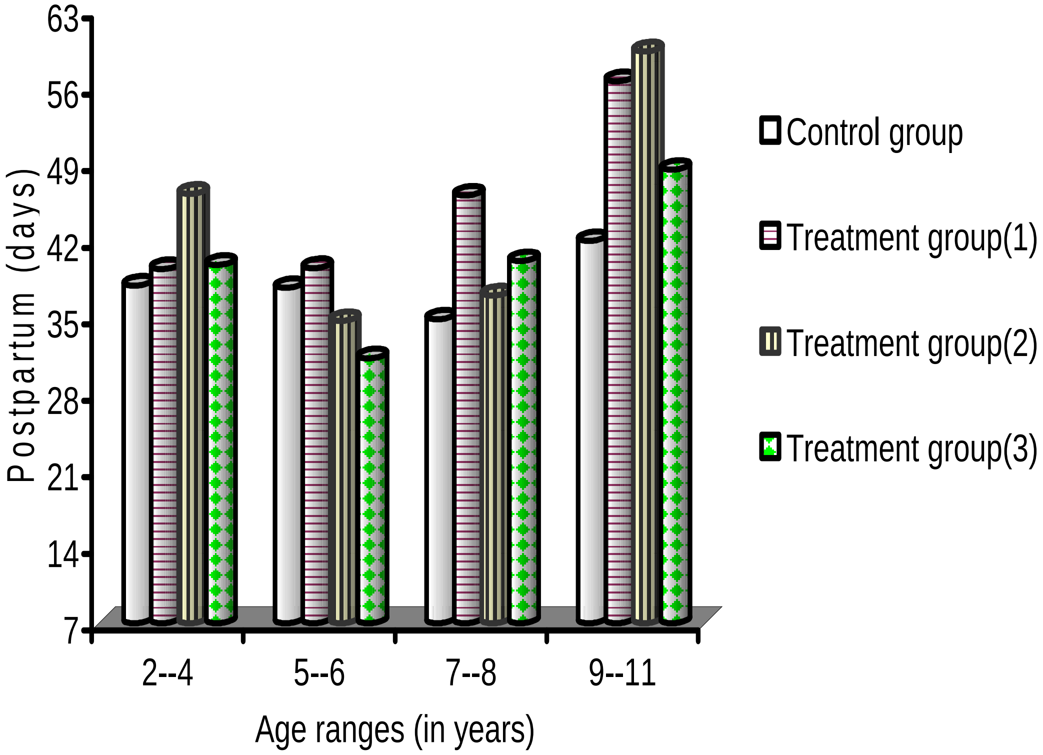

Figure 2. Effect of age on first postpartum ovarian activity in the control group (C) and the treatment groups (1), (2) and (3).

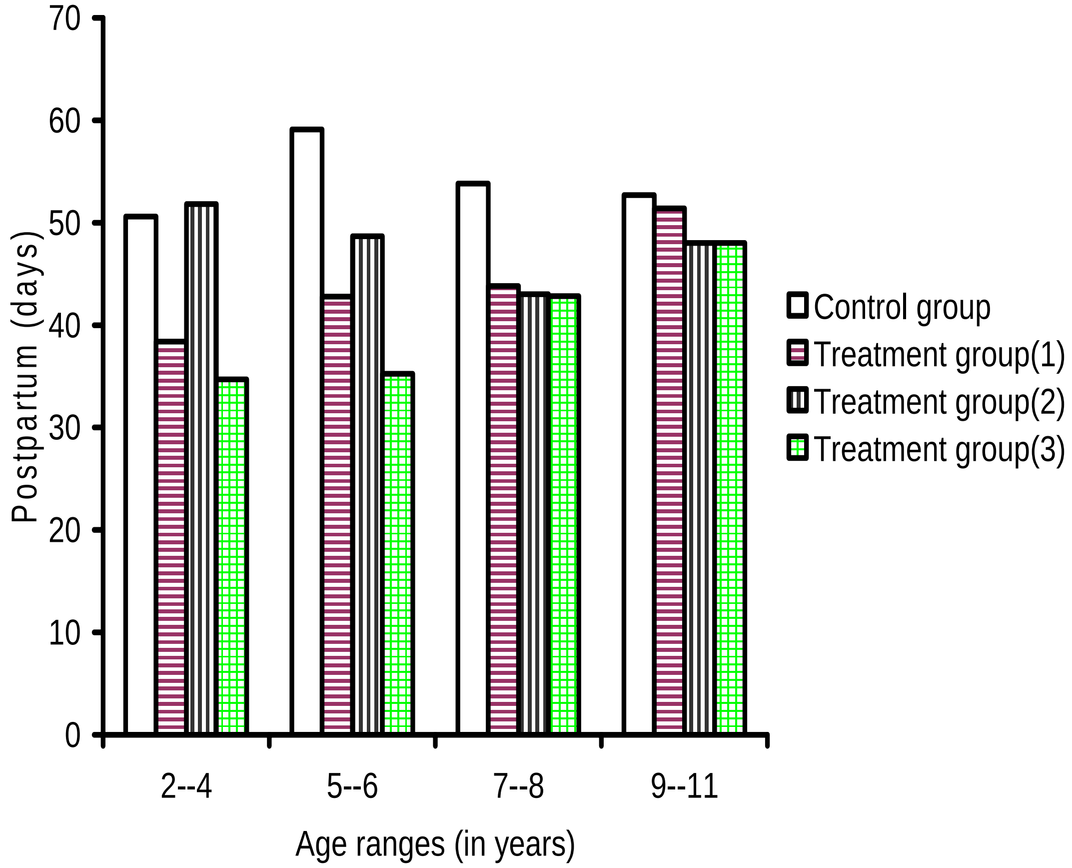

Figure 3. Effect of age on the appearance of first postpartum oestrus in the control group (C) and the treatment groups (1), (2) and (3).

days and 34.7±14.5 days, respectively, while the treatment group (2) attained 43.0±8.8 days, at the age range of 7-8 years.

Strong significant differences ($p<0.05$) were found between the control group and both treatment groups (1) and (3). No significant differences ($p\leq0.05$) were found between the remainder groups.

3.2.1.4: Effect of age on number of services per conception:

As illustrated in Figure (4) the highest numbers of services per conception achieved in the control and treatment groups (1), (2) and (3) were 4.0±2.3, 4.5±2.0, 4.4±1.5 and 3.9±1.8, respectively, at the age ranges of 5-6 years, 9-11 years, 7-8 years and 2-4 years, respectively.

The lowest rate recorded in the control group was 3.0±2.3 at the age range of 9-11 years, while treatment group (2) recorded 3.6±2.0, at the age range of 2-4 years, however, treatment groups (1) and (3) recorded 3.4±1.5 and 2.1±1.4, at similar age range of 5-6 years.

There were weak significant differences ($p<0.05$) between the treatment group (1) and both the control group and treatment group (3). No significant differences ($p<0.05$) were found between the remainder groups.

3.2.1.5: Effect of age on open period:

Shown in Figure (5). The control group recorded 120.0±32.7 days, at the age range of 5-6 years, as longest period, while treatment group (3) recorded 109.4±26.9 days, at the age range of 2-4 years, and treatment groups (1) and (2) recorded 134.2 ±28.1 days and 121.0±16.5 days, respectively, at the same age range of 9-11 years.

The shortest period recorded in the control group was 104.9±31.4 days, at the age range of 7-8 years, while treatment groups (1), (2) and (3) attained 98.3±34.5 days, 106.5±24.9 days and 82.3±8.4 days, at similar age range of 5-6 years.

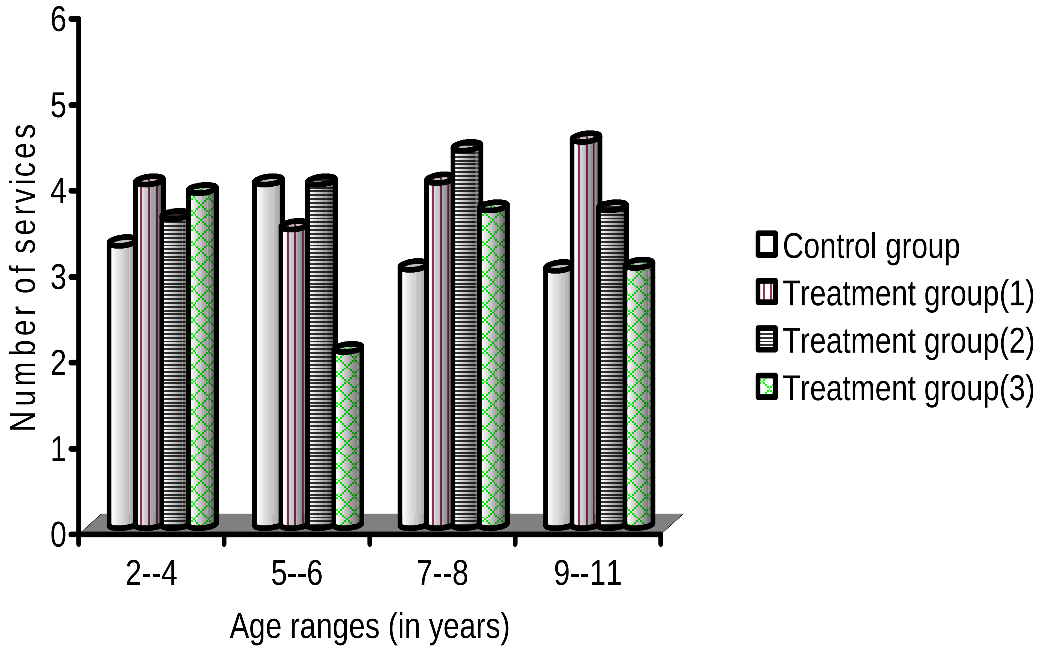

Figure 4. Effect of age on number of services per conception in the control group (C) and the treatment groups (1), (2) and (3).

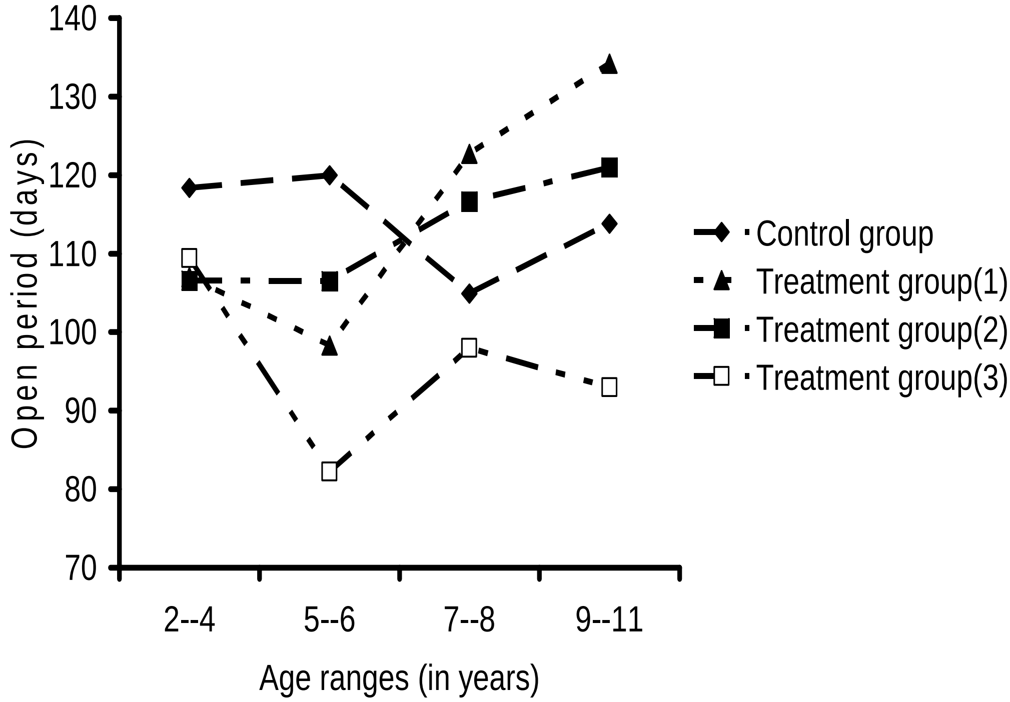

Figure 5. Effect of age on days open in the control group (C) and the treatment groups (1), (2) and (3).

A strong significant difference ($p<0.05$) was computed between the control group and the treatment group (3), while there were weak significant differences ($p<0.05$) between the treatment group (3) and both treatment groups (1) and (2). No significant differences ($p<0.05$) were found between the other groups.

3.2.2: Effect of parity on postpartum traits in the control and the treatment groups:

3.2.2.1: Uterine involution process:

Figure (6) revealed the effect of parity on uterine involution process in the four experimental groups. The longest period recorded in the control group was 40.3±4.0 days, while the treatment groups (1), (2) and (3) recorded 29.6±5.3 days, 35.0±1.0 days and 25.0±5.6 days, respectively, at the same parity range of 8-9 calvings.

The shortest period achieved in both the control and treatment groups (1), (2) and (3) were 27.0±8.0 days, 23.9±7.5 days, 19.7±7.5 days and 21.0±5.7 days, respectively, at similar parity range of 1-3 calvings.

There were strong significant differences ($p<0.05$) between the control group and treatment groups (1), (2) and (3), while weak significance differences ($p\leq0.05$) were recorded between the treatment group (1) and both treatment groups (2) and (3). No other significant differences ($p\leq0.05$) were found.

3.2.2.2: First postpartum ovarian activity:

As shown in Figure (7) the control group and both treatment groups (1) and (2) recorded the period of 55.1±19.4 days, 79.8±33.5 days and 67.5±24.3 days, respectively, as the longest days to reach the first postpartum ovarian activity, and that was at the same parity range of 8-9 calvings, while treatment group (3) recorded the period of 54.3±31.0 days, at parity range of 6-7.

The shortest average recorded in the control group was 34.9±13.1 days, at parity

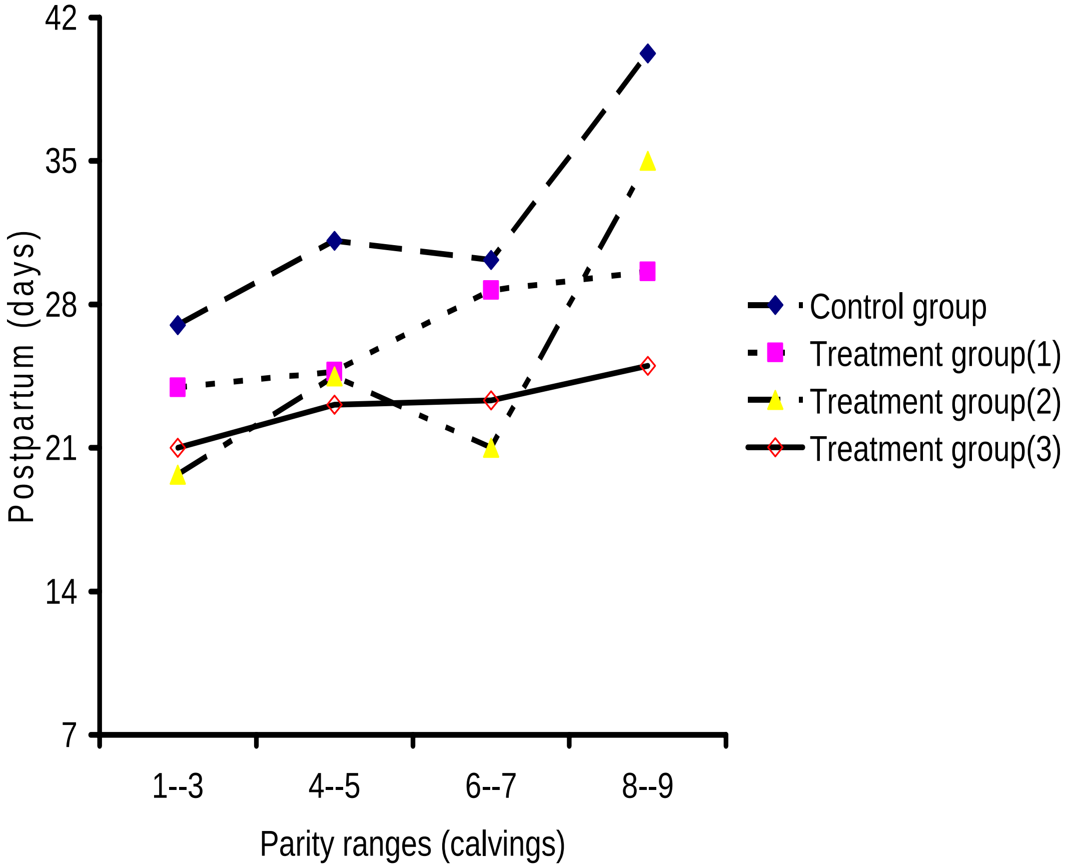

Figure 6. Effect of parity on uterine involution process in the control group (C) and the treatment groups (1), (2) and (3).

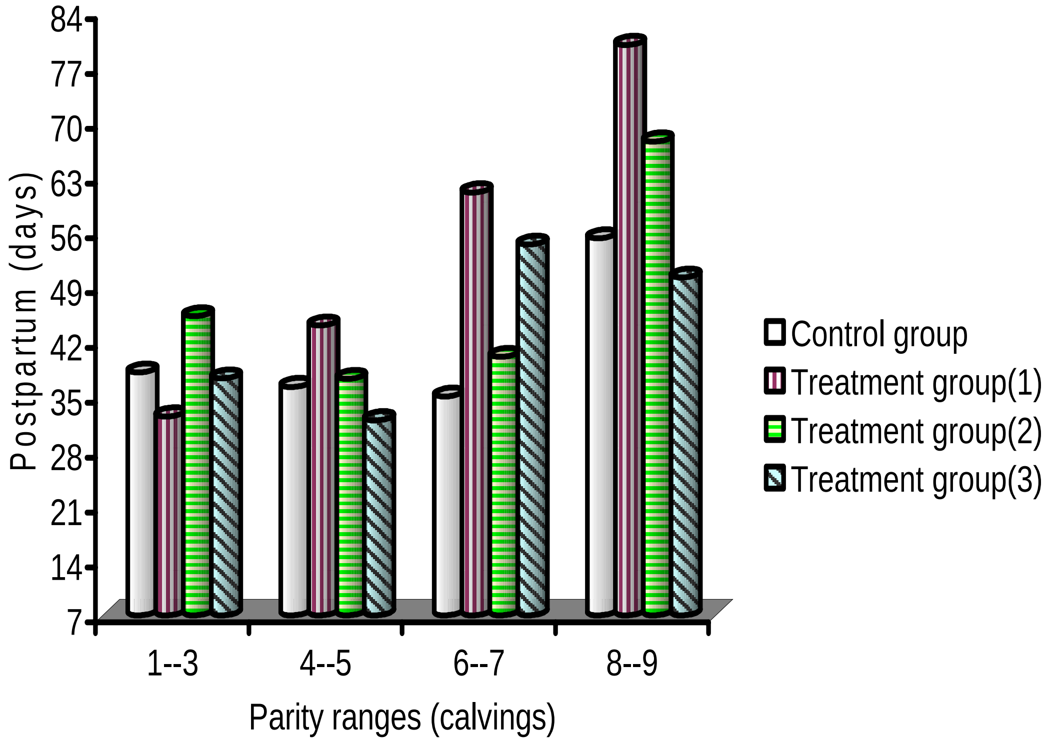

Figure 7. Effect of parity on the first postpartum ovarian activity in the control group (C) and the treatment groups (1), (2) and (3).

range of 6-7 calvings, while treatment group (1) recorded 39.3±13.0 days, at parity range of 1-3 calvings. Hence both treatment groups (2) and (3) recorded 37.2±14.3 days and 31.9±7.0 days, respectively, at the same parity range of 4-5 calvings.

A strong significant difference ($p<0.05$) was found between the control group and treatment group (1). However, No significant differences ($p\leq0.05$) were recorded between the other groups.

3.2.2.3: Occurrence of first postpartum oestrus:

In Figure (8) the longest period attained in both the control group and treatment group (1) were 69.4±39.4 days and 71.8±35.9 days, respectively, at similar parity range of 8-9 calvings, while treatment groups (2) and (3) recorded 54.5±30.6 days and 51.4±20.9 days, respectively, at similar parity range of 6-7 calvings.

The shortest period reported in the control group was 42.8±17.5 days, at parity range of 6-7 calvings, whereas, the treatment groups (1) and (2) recorded 42.1±19.7 days and 41.3±11.5 days, respectively, at the same parity range of 4-5 calvings, while treatment group (3) recorded 34.0±14.8 days, at parity range of 1-3 calvings.

A strong statistical significant difference ($p\leq0.05$) was existed between the control group and the treatment group (3), while a weak significant difference ($p\leq0.05$) was computed between the control group and treatment group (1). No significant differences ($p\leq0.05$) were counted between the other groups.

3.2.2.4: Number of services per conception:

Figure (9) shows that the large number of services was recorded first in treatment group (1) with 4.6±1.5, at parity range of 8-9 calvings, followed by treatment group (2), the control group and treatment group (3) with 3.7±1.8, 3.4±2.5 and 3.0±1.5, at parity ranges 4-5 calvings and 8-9 calvings for the late two groups.

The least number of services reported in the control group was 2.6±1.5, at parity

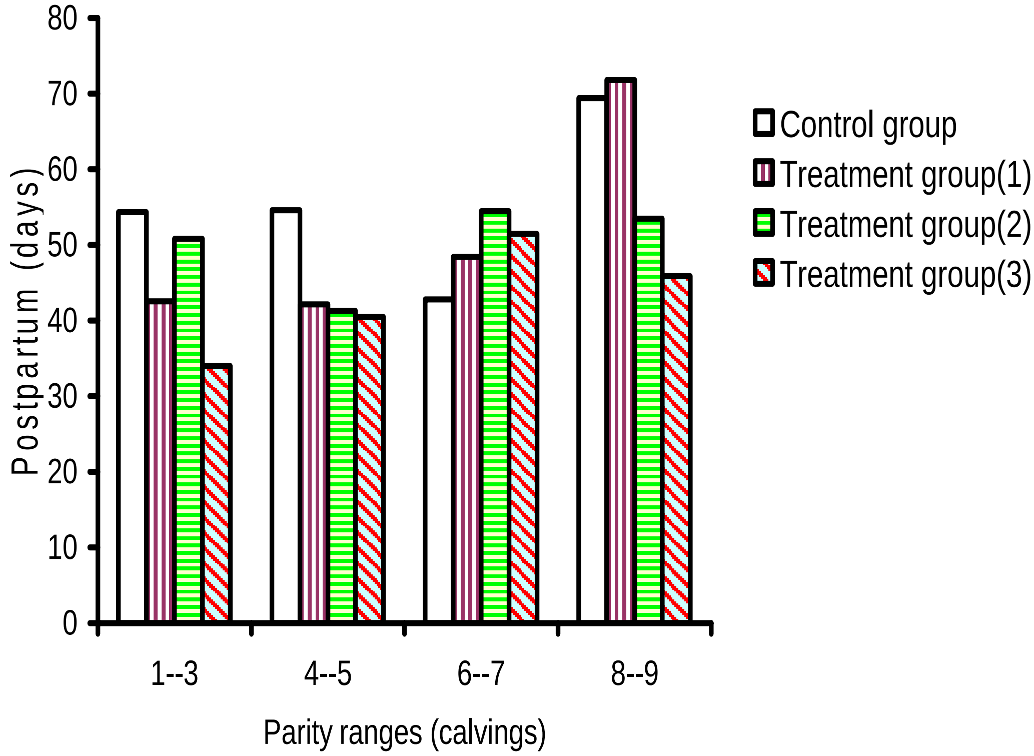

Figure 8. Effect of parity on the exhibition of first postpartum oestrus in the control group (C) and the treatment groups (1), (2) and (3).

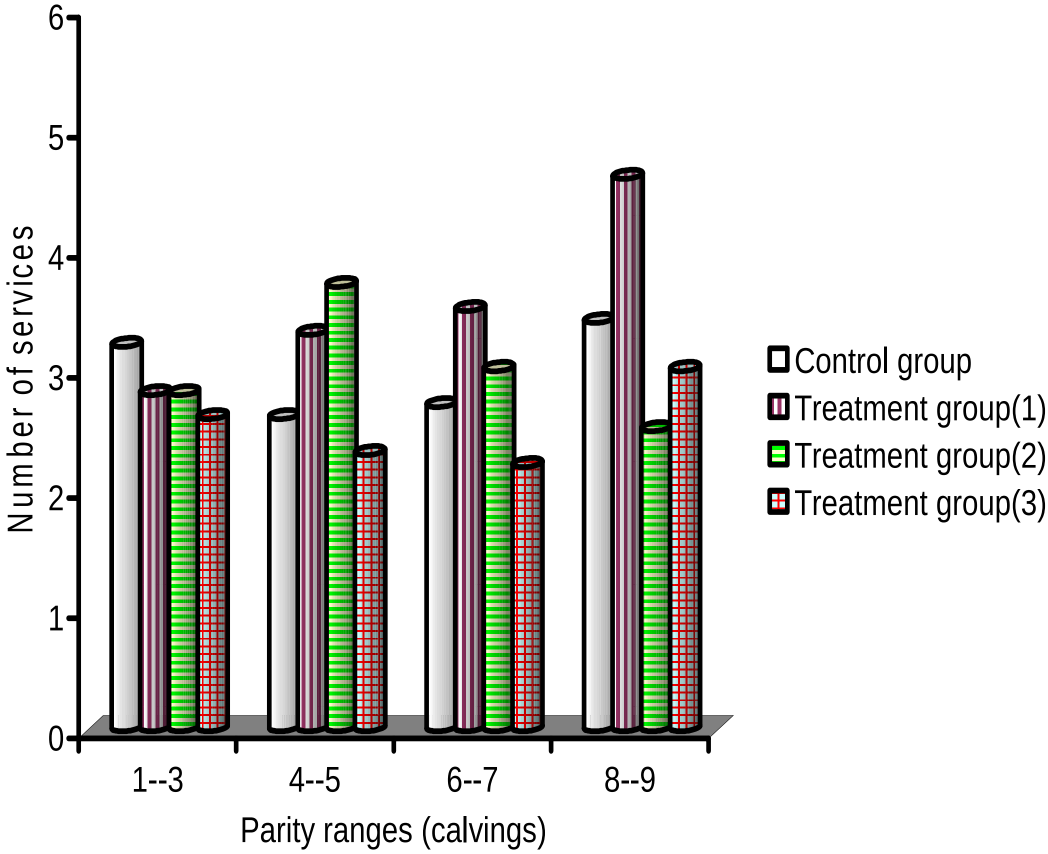

Figure 9. Parity effect on number of services per conception in the control group (C) and the treatment groups (1), (2) and (3).

range of 4-5 calvings, while treatment groups (1), (2) and (3) recorded 2.8±1.5, 2.5±2.1 and 2.2±1.8, at parity ranges of 1-3 calvings, 8-9 calvings and 6-7 calvings, respectively.

A weak significant difference ($p<0.05$) was existed between the treatment groups (1) and (3), while no significant differences ($p<0.05$) were counted between the other groups.

3.2.2.5: Open period:

In Figure (10) the longest open period recorded in both the control and treatment group (1) were 144.0±33.1 days and 142.0±35.4 days, respectively, at similar parity range of 8-9 calvings, while the treatment groups (2) and (3) recorded 121.7±45.1 days and 103.2±26.4 days, at parity ranges of 6-7 calvings and 1-3 calvings, respectively.

The shortest open period recorded in the control and treatment group (3) were 107.0±34.5 days and 88.1± 34.0 days, at the same parity range of 6-7 calvings, whereas, treatment groups (1) and (2) recorded 103.9±31.3 days and 114.0±31.7 days, respectively, at similar parity range of 1-3 calvings.

Strong significant differences ($p\leq0.05$) were encountered between the control group and treatment group (3), and between the treatment group (3) and both treatment groups (1) and (2). However, no significant differences ($p\leq0.05$) were found between the remainder groups.

3.2.3: Effect of body weight on postpartum traits in the control and treatment groups:

3.2.3.1: Uterine involution process days:

Figure (11) shows that the slowest uterine involution process achieved in the

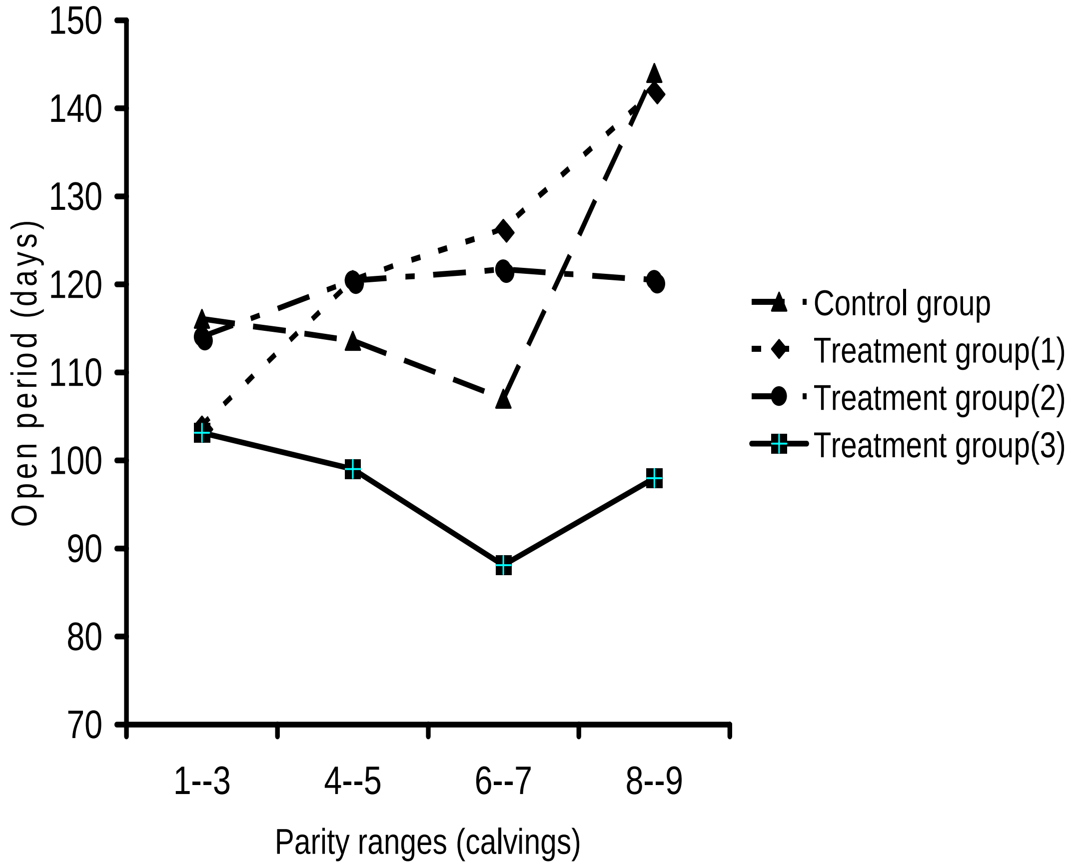

Figure 10. Effect of parity on the open period in the control group (C) and the treatment groups (1), (2) and (3).

control group was 33.8±8.7 days, at body weight range of 401-500 kg, while treatment groups (1), (2) and (3) attained uterine involution in 28.0±9.6 days, 26.0±11.5 days and 26.6±6.0 days respectively, at the same body weight range of 501-600 kg.

The fastest uterine involution have been observed in both the control and the treatment groups (1) and (3) were 26.5±8.3 days, 21.9±5.3 days and 22.5±4.2 days, respectively, at similar body weight range of 301-400 kg, while treatment group (2) recorded 18.7±7.5 days, at body weight range of 201-300 kg.

Strong significant differences ($p<0.05$) were found between the control group and the three treatment groups. However, no significances ($p<0.05$) were found between the treatment groups.

3.2.3.2: First postpartum ovarian activity:

In Figure (12) the longest period recorded for the first commencement of postpartum ovarian activity in the control group and the treatment groups (1), (2) and (3) were 39.7±12.2 days, 71.8±29.8 days, 51.5±25.3 days and 46.0±28.4 days respectively, at body weight ranges of 201-300 kg, 501-600 kg, 301-400 kg and 401-500 kg, respectively.

The shortest averages recorded in the control group and the treatment group (3) were 37.0±11.5 days and 38.3±17.8 days, respectively, at the same body weight range of 301-400 kg, while treatment groups (1) and (2) achieved 34.9±8.0 days and 36.9 ±13.6 days, respectively, at the same body weight range of 201-300 kg, respectively. There was a strong significant difference ($p\leq0.05$) between the control group and treatment group (1). No significant differences ($p\leq0.05$) were recorded between the other groups.

3.2.3.3: Occurrence of first postpartum oestrus:

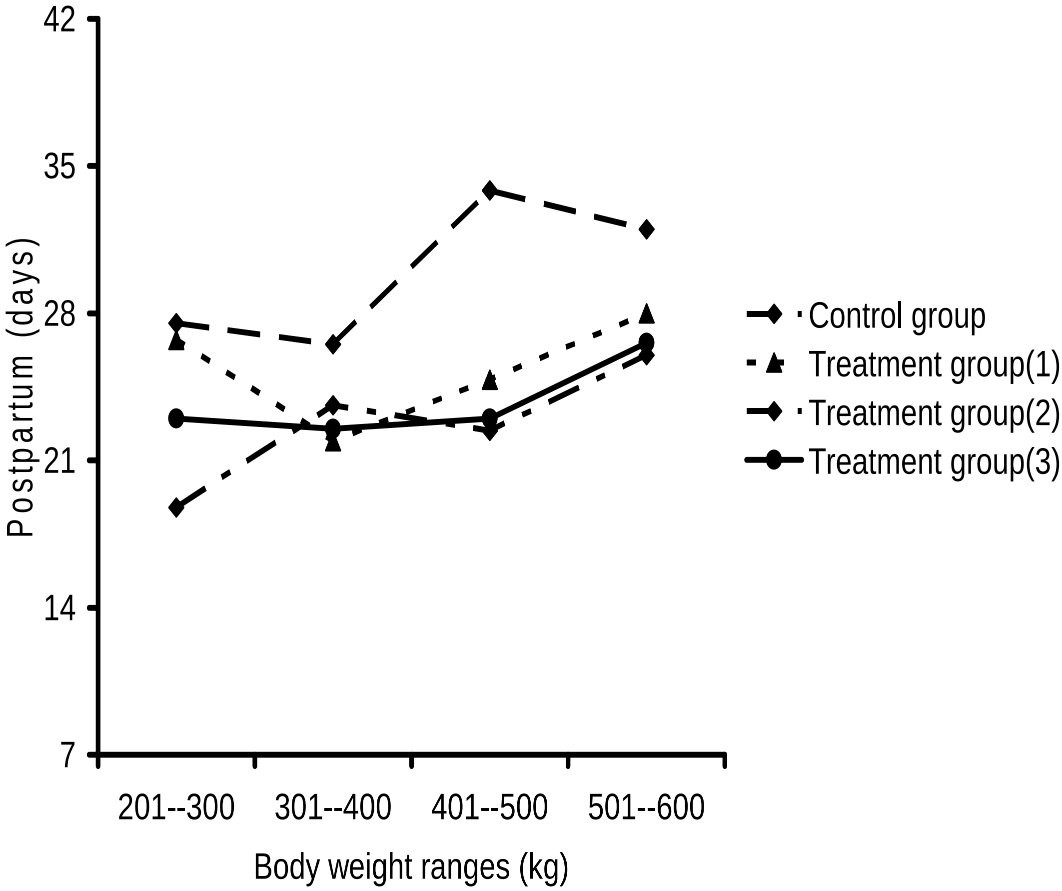

Figure 11. Effect of body weight on uterine involution process in the control group (C) and the treatment groups (1), (2) and (3).

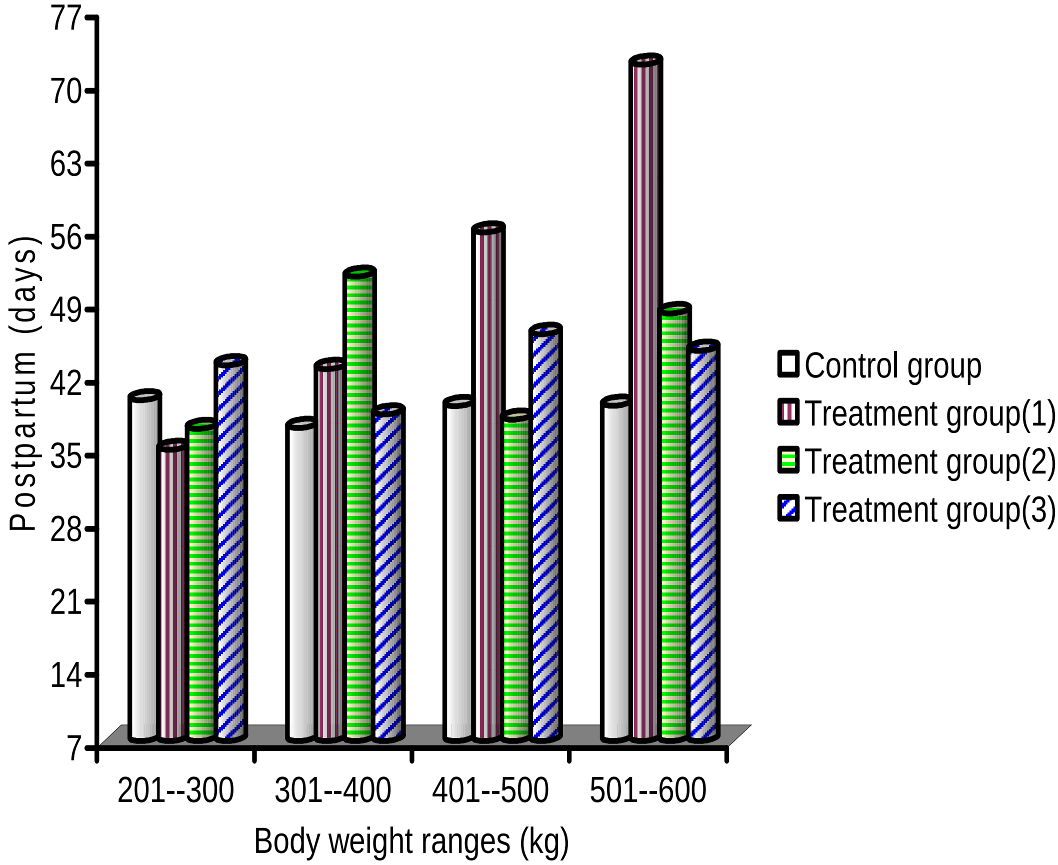

Figure 12. Effect of body weight on the first postpartum ovarian activity in the control group (C) and the treatment groups (1), (2) and (3).

Figure (13) shows that the longest period recorded in the control and the treatment groups (2) were 61.5±29.5 days and 53.8±33.0 days, at similar body weight range of 201-300 kg, while the treatment groups (1) and (3) recorded 60.3±34.5 days and 47.8±19.0 days, respectively, at body weight ranges of 501-600 kg and 401-500 kg, respectively.

The shortest period registered in the control and treatment group (2) were 48.7±28.0 days and 43.9±17.0 days, respectively, at similar body weight range of 401-500 kg, while treatment groups (1) and (3) recorded 41.8±16.7 days and 35.8±13.8 days, respectively, at the same body weight range of 301-400 kg.

A strong significant difference ($p<0.05$) was found between the control group and treatment group (3), while a weak significant difference ($p\leq0.05$) was found between the control group and treatment group (1). No significant differences ($p\leq0.05$) were recorded between the other groups.

3.2.3.4: Number of services per conception

Figure (14) showed that the highest number of services registered in the control group was 3.3±2.2, at body weight range of 301-400 kg compared with 3.9±1.8 and 3.5±1.6, at the same body weight range of 501-600 kg in the treatment groups (1) and (2), respectively, while treatment group (3) recorded 3.5±1.6, at body weight range of 201-300 kg.

The lowest numbers of services recorded in the control group and the treatment groups (1) and (3) were 2.0±2.0, 2.3±1.9 and 2.9±1.5, respectively, and that was at the same body weight range of 401-500 kg, while the treatment group (2) recorded 2.9± 1.6, at body weight range of 201-300 kg.

A weak significant difference ($p<0.05$) between the control group and treatment group (1) was found. No significant differences ($p<0.05$) were computed between the

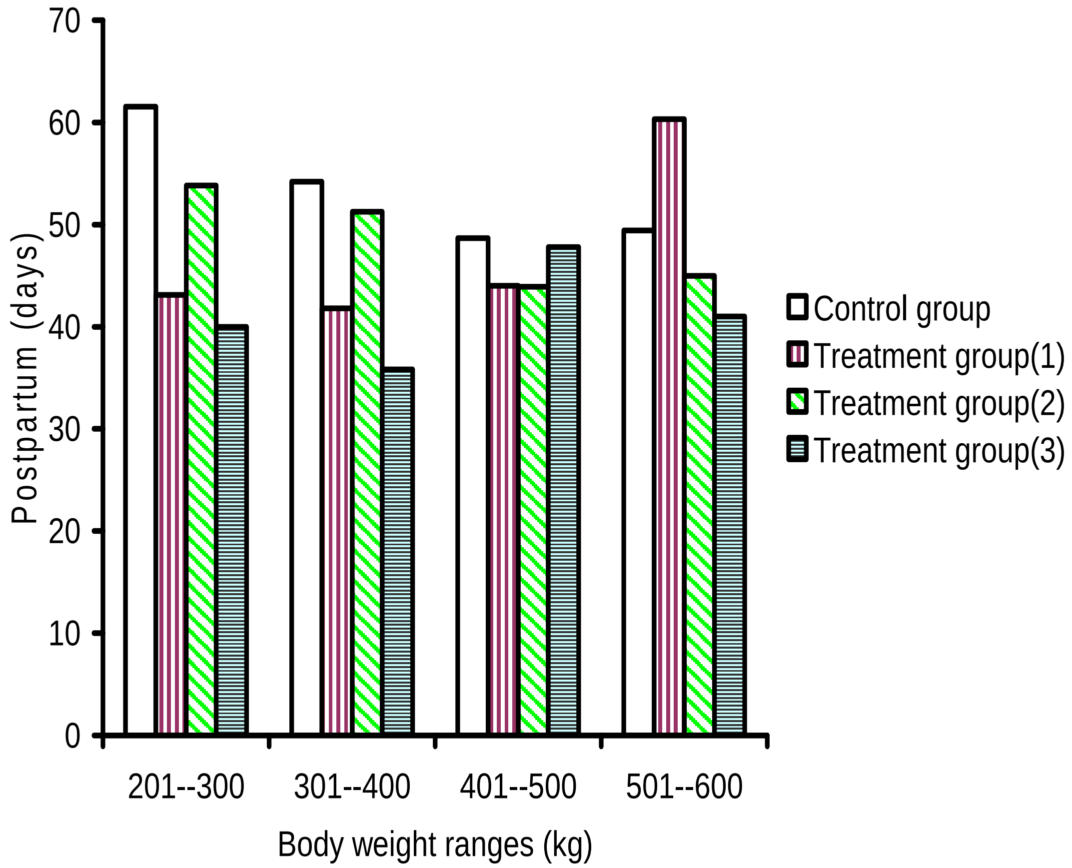

Figure 13. Effect of body weight on the occurrence of first postpartum oestrus in the control group (C) and the treatment groups (1), (2) and (3).

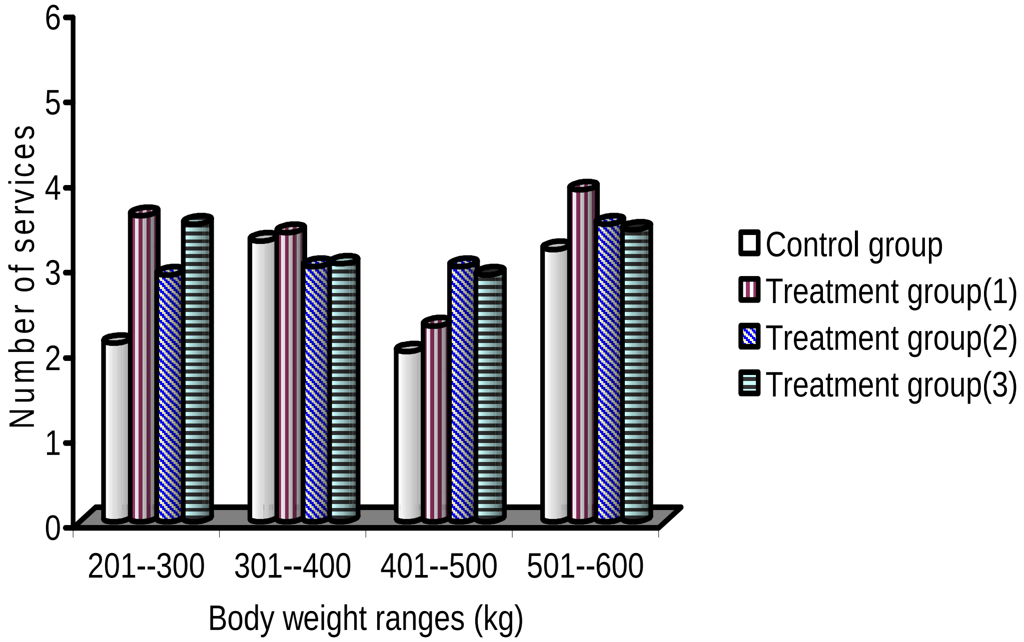

Figure 14. Effect of body weight on number of services per conception rate in the control group (C) and treatment groups (1), (2) and (3).

remainder groups.

3.2.3.5: Open period:

As shown in Figure (15) the longest period recorded in the control group was 119.7±32.0 days, at body weight range of 301-400 kg, while treatment groups (1), (2) and (3) recorded 122.1±37.3 days, 125.6±15.8 days and 117.7±23.8 days, respectively, at body weight range of 401-500 kg, 501-600 kg and 201-300 kg, respectively .

The least period recorded in both the control group and treatment group (2) were 110.6±34.0 days and 113.2±31.5 days, at similar body weight range of 401-500 kg, while treatment groups (1) and (3) recorded 107.8±32.7 days and 91.2±18.7 days, respectively, at body weight ranges of 501-600 kg and 301-400 kg, respectively.

A strong significant difference ($p<0.05$) was existed between treatment groups (2) and (3), while weak significant differences ($p<0.05$) were found between the treatment group (3) and both the control group and the treatment group (1). No other significant differences ($p<0.05$) were recorded.

3.2.4: Effect of foreign blood percentage on postpartum reproductive traits in the control and treatment groups:

3.2.4.1: Uterine involution process:

As shown in Figure (16) the longest averages period recorded in both the control group and treatment group (3) were 34.4±29.4 days and 25.0±4.4 days, at blood percentage ranges of 50-62.5 and 87.5-99.9, respectively, whereas, the treatment groups (1) and (2) recorded 28.0±7.5 days and 24.5±10.3 days, at similar foreign blood range of 62.5-75 percent.

The shortest averages period recorded in both the control group and treatment group (2) were 26.1±6.3 days and 19.6±8.0 days, at blood percentage

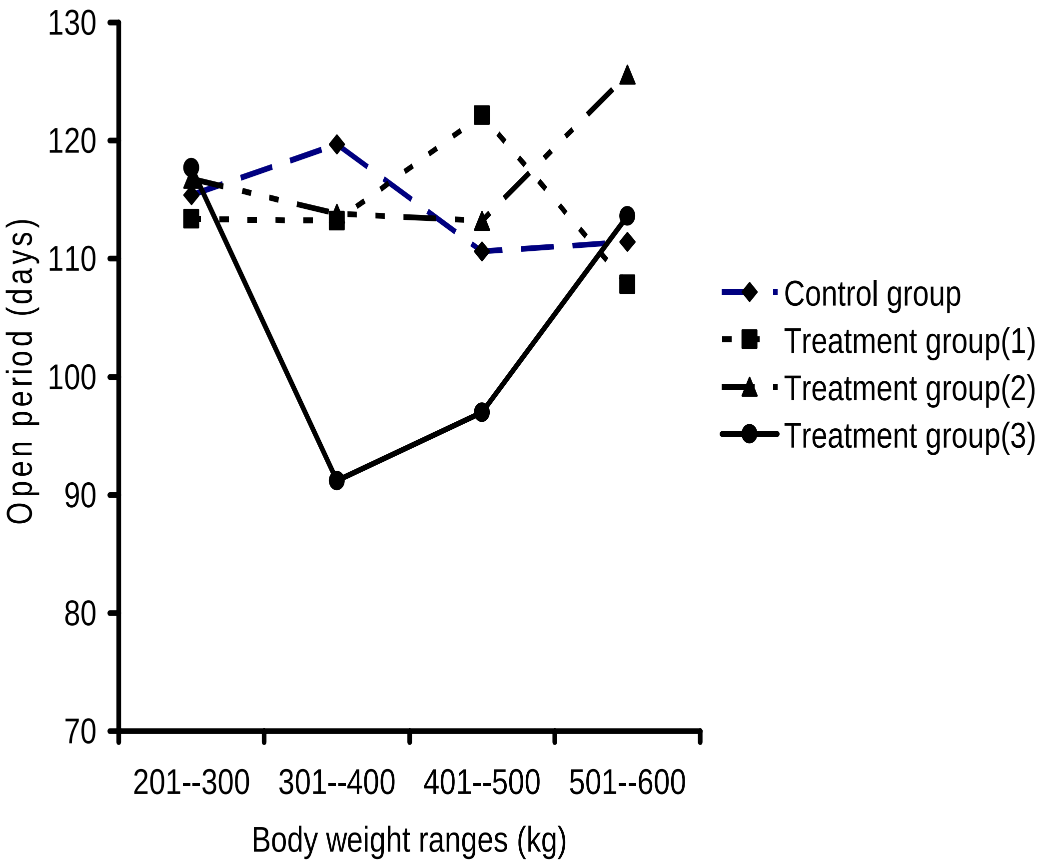

Figure 15. Effect of body weight on days open in the control group (C) and the treatment groups (1), (2) and (3).

ranges of 62.5-75 and 50-62.5, respectively, while treatment groups (1) and (3) recorded 24.4±8.4 days and 21.6±3.6 days, respectively, at the same range of 75-87.5 percent.

There were strong significant differences ($p<0.05$) between the control group and treatment groups (1), (2) and (3), while there was a weak significant difference ($p\leq0.05$) between the treatment groups (1) and (2). No significant differences ($p<0.05$) were existed between the other groups.

3.2.4.2: First postpartum ovarian activity:

In Figure (17) the longest average period recorded in the control group for the first postpartum ovarian activity was 42.6±16.3 days, at blood percentage range of 87.5-99.9, whereas, the treatment group (3) recorded 45.8±30.2 days, at blood percentage range of 50-62.5. Treatment groups (1) and (2) recorded 50.7±28.6 days and 51.4±31.5 days, respectively, at the same blood percentage range of 75-87.5.

The shortest averages period achieved in both the control and treatment group (1) were 34.5±7.0 days and 43.1±18.6 days, respectively, at the same blood percentage range of 50-62.5, while the treatment groups (2) and (3) recorded 38.8± 12.1 days and 40.8±15.1 days, respectively, at blood percentage ranges of 87.5-99.9 and 75-87.5, respectively .

No significant differences ($p<0.05$) were encountered between the all combinations.

3.2.4.3: Occurrence of the first postpartum oestrus:

As revealed in Figure (18) the longest mean period recorded in the control group was 66.6±32.0 days, at blood percentage range of 62.5-75, followed by the treatment groups (1), (2) and (3) with 54.4±21.2 days, 49.3±26.1 days and 43.5±12.7, respectively, at blood percentage ranges of 62.5-75, 50-62.5 and 75-87.5,

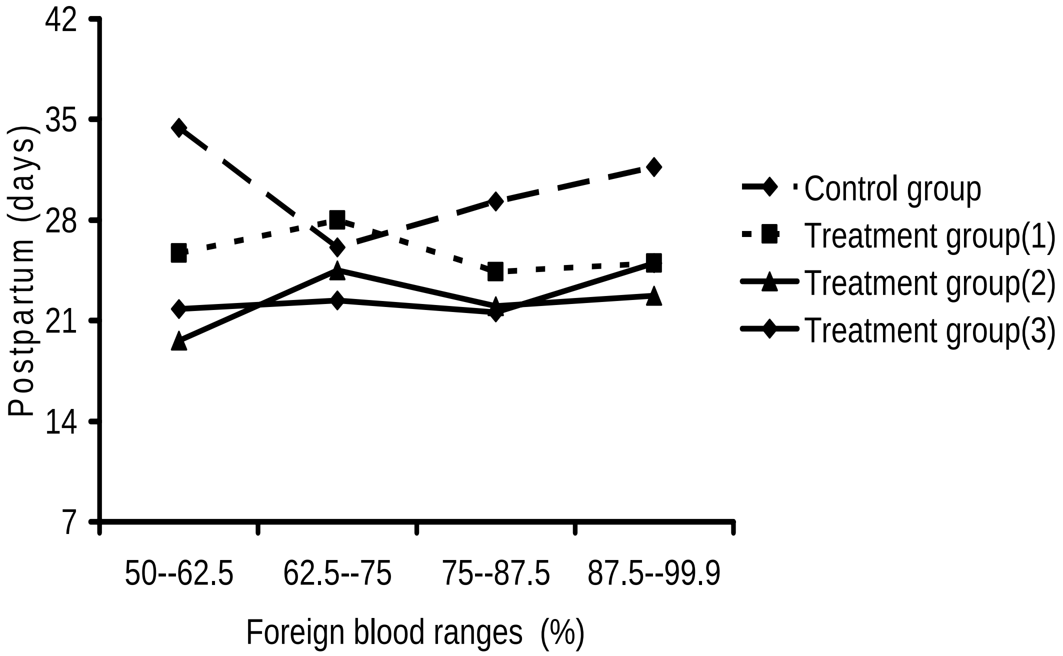

Figure 16. Effect of foreign blood percentage on uterine involution process in the control group (C) and the treatment groups (1), (2) and (3).

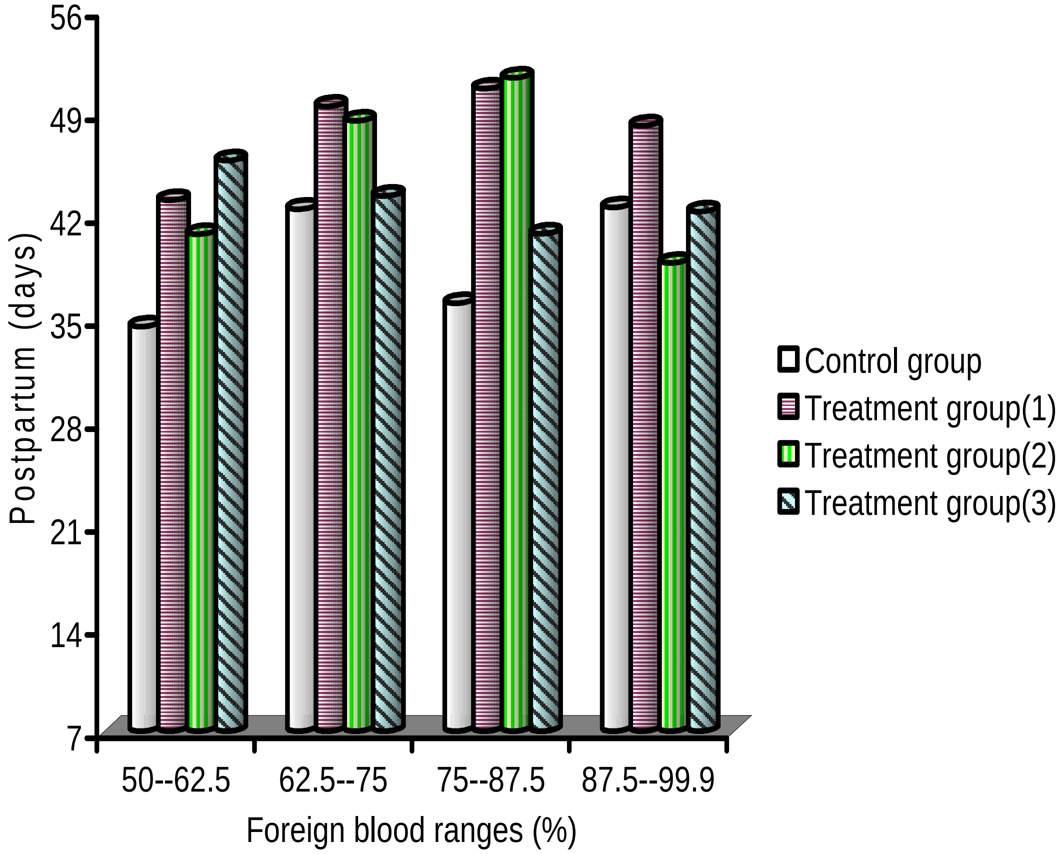

Figure 17. Effect of foreign blood percentage on the first postpartum ovarian activity in the control group (C) and the treatment groups (1), (2) and (3).

respectively.

The shortest mean period recorded in the control group was 45.0±11.8 days, at blood percentage range of 50-62.5, whereas treatment group (1) recorded 39.4±16.6 days, at blood percentage range of 87.5-99.9. Treatment groups (2) and (3) recorded 44.7±24.8 days and 37.8±19.4 days, respectively, at the same blood percentage range of 62.5-75.

A strong significant difference ($p \leq 0.05$) has been detected between the control group and treatment group (3). No significant differences ($p \leq 0.05$) were recorded between the other groups.

3.2.4.4: Number of services per conception:

Figure (19) shows that the maximum numbers of services recorded in both the control group and the treatment group (3) were 3.5±2.0 and 3.0±1.3, respectively, at the same blood percentage range of 50-62.5, while treatment groups (1) and (2) recorded 4.2±2.1 and 3.5±2.3, respectively, at the same blood percentage range of 62.5-75.

Furthermore, the least numbers of services recorded in the control group and treatment groups (1) and (3) were 2.3±2.0, 2.4±1.8 and 2.0±2.1, respectively, at the same blood percentage range of 75-87.5, whereas treatment group (2) recorded 2.2±1.4, at blood percentage range of 50-62.5.

There was a weak significant difference ($p<0.05$) between the control group and treatment group (3), while a strong significant difference ($p<0.05$) was found between the treatment groups (1) and (3). No significant differences ($p \leq 0.05$) were existed between the remainder groups.

3.2.4.5: Open period:

The effect of foreign blood percentage on the open period is illustrated

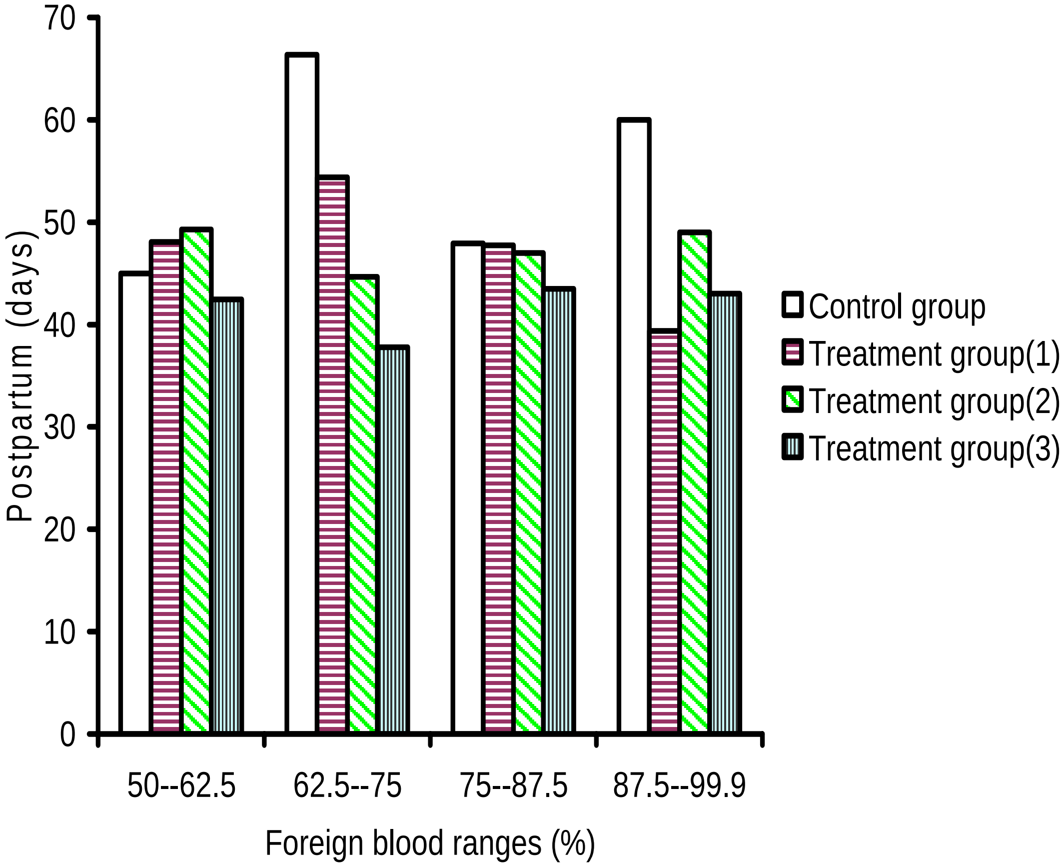

Figure 18. Effect of foreign blood percentage on the occurrence of first postpartum oestrus in the control group (C) and the treatment groups (1), (2) and (3).

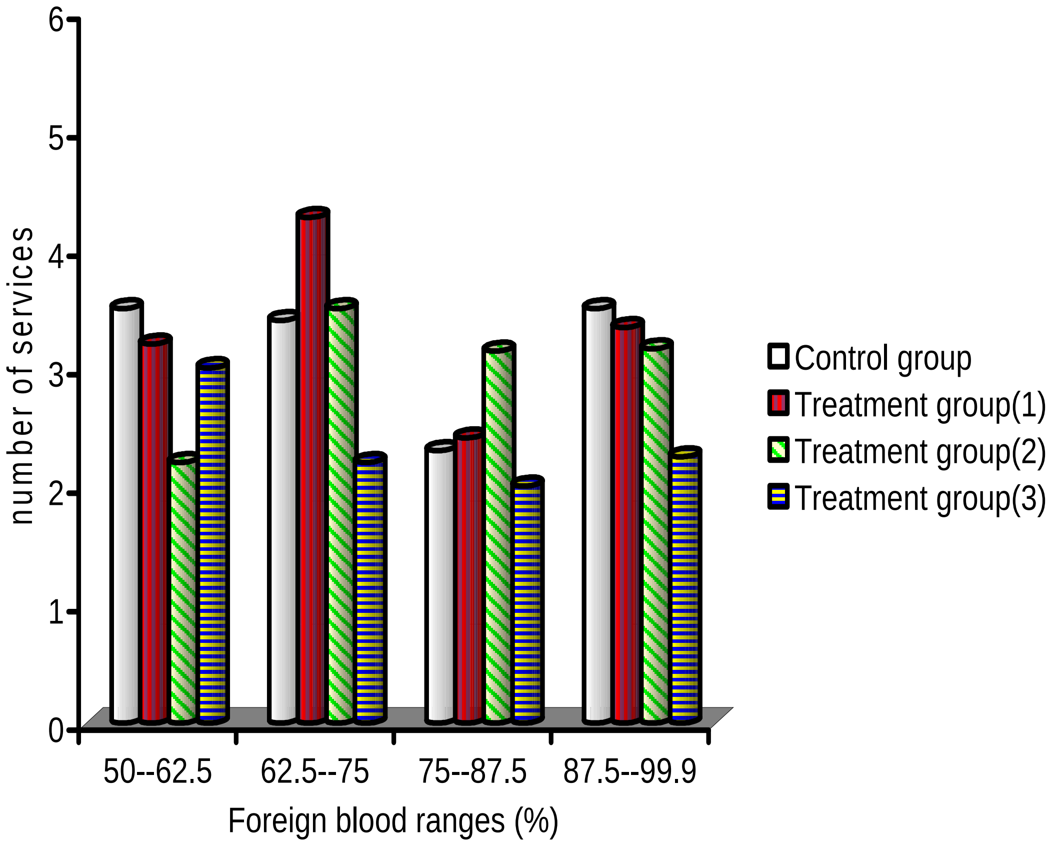

Figure 19. Effect of foreign blood percentage on number of services per conception in the control group (C) and the treatment groups (1), (2) and (3).

in Figure (20). The longest period registered in the control and the treatment groups (1) and (3) were 127.6±22.1 days, 121.8±34.3 days and 108.6±26.2 days, respectively, at the same blood percentage range of 50-62.5, while treatment group (2) recorded 126.8±24.3 days, at blood percentage range of 87.5-99.9.

The shortest days open recorded in the control group was 102.0±37.0 days, at blood percentage range of 75-87.5, while the treatment groups (1), (2) and (3) recorded 109.0±32.5 days, 101.1±26.8 days and 88.2±28.5 days, respectively, at blood percentage ranges of 75-87.5, 50-62.5 and 87.5-99.9, respectively.

Strong significant differences ($p<0.05$) were recorded between the control group and the treatment group (3), as well as between the treatment group (3) and both treatment groups (1) and (2). No other significant differences ($p<0.05$) were computed.

3.2.5: Effect of season on postpartum reproductive traits in the control and the treatment groups:

3.2.5.1: Uterine involution process:

Figure (21) shows that the averages period to complete uterine involution in the control and treatment groups (1), (2) and (3) were 35.0±7.2 days, 26.2±7.5 days, 28.0±7.8 days and 25.2±5.7 days, respectively, in summer, while they were 29.6±13.1 days, 24.5±5.5 days, 20.8±7.5 days and 23.5±4.1 days, respectively, in autumn. The uterine involution days recorded in winter for the four groups were 24.7±7.4 days, 26.6±8.7 days, 21.2±8.5 days and 21.0±4.1 days, respectively.

There were strong significant differences ($p<0.05$) between the control group and both treatment groups (1) and (3) in summer, and between the control group and treatment group (2) in autumn, while the control group had a weak significant relation ($p<0.05$) with treatment group (2) in summer, as well as with treatment group

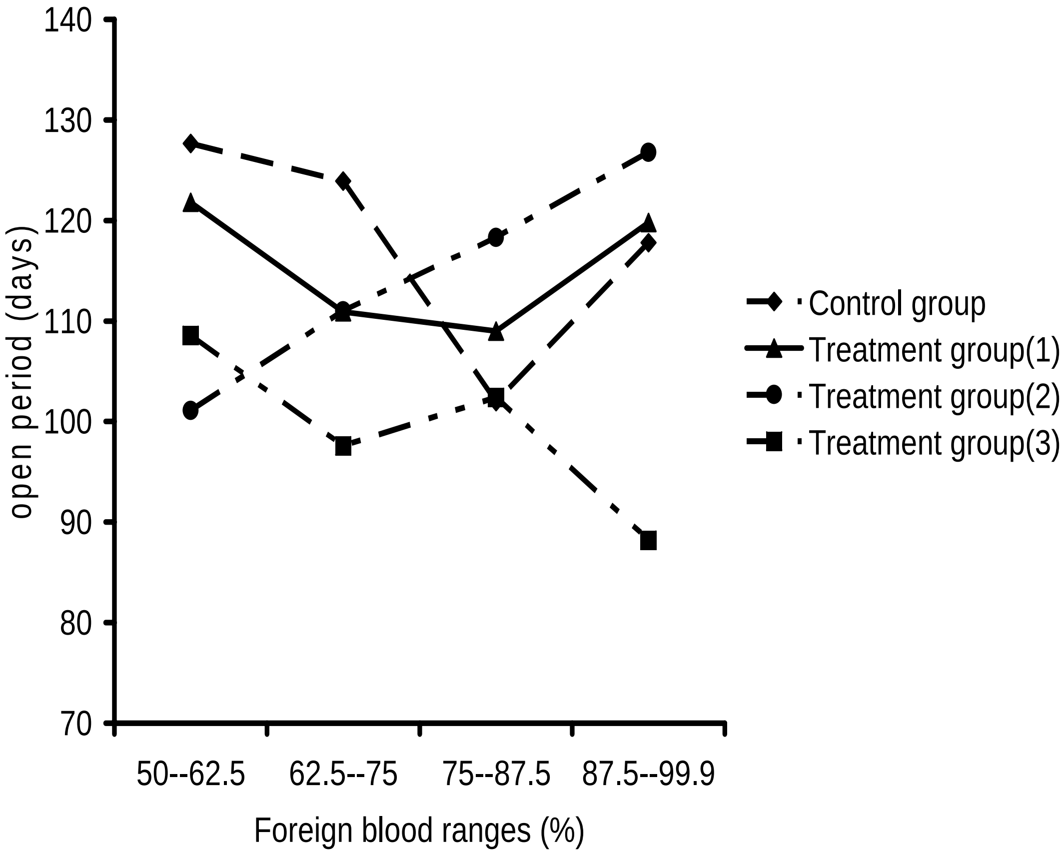

Figure 20. Effect of foreign blood percentage on open period in the control group (C) and the treatment groups (1), (2) and (3).

Table 8. The effect of season on incidence of retained placenta in cross bred dairy cows

Season	Total clinical cases observed	Retained placenta cases	
		Number of animals	Percentage
Summer	٥٨	٤٢	١٧ %
Autumn	٩٤	٦٧	٢٧ %
Winter	٩٦	٥٥	22 %
Total	٢٤٨	١٦٤	66 %

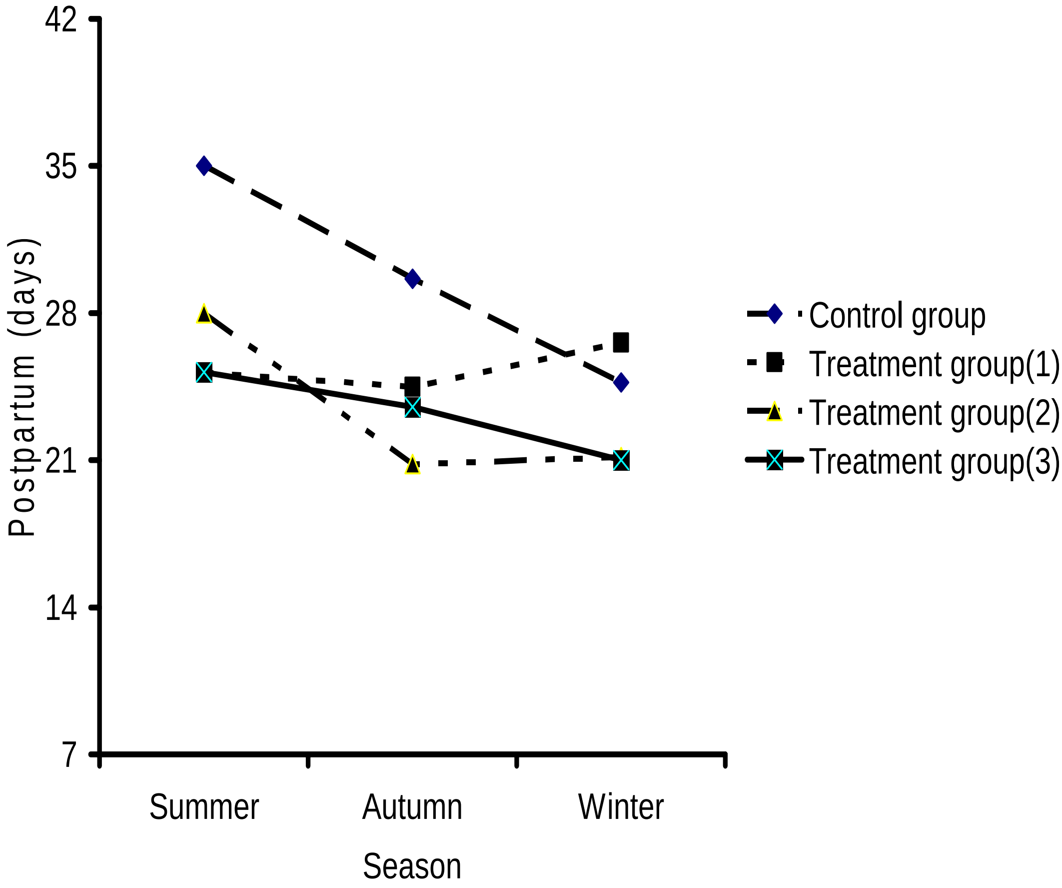

Figure 21. Effect of season on uterine involution process in the control group (C) and the treatment groups (1), (2) and (3).

(1) and (3) in autumn besides with treatment group (3) in winter. A weak significant difference ($p<0.05$) was found between the treatment groups (1) and (3) in winter. No other significant differences ($p<0.05$) were observed.

3.2.5.2: First postpartum ovarian activity:

Figure (22) shows the effect of season on appearance of first postpartum ovarian activity. The averages days recorded in the control group and the treatment groups (1), (2) and (3) were 44.2±13.0 days, 64.8±25.6 days, 61.5±30.0 days and 56.5±30.6 days, respectively, in summer, whereas they were 36.6±15.1 days, 45.5± 20.0 days, 36.6±16.7 days and 40.0±17.0 days, respectively, in autumn. The same groups achieved 35.3±10.2 days, 42.9±21.0 days, 44.1±21.4 days and 34.6±11.4 days, respectively, in winter.

Weak significant differences ($p<0.05$) were found between the control group and treatment group (1) in summer and autumn, as well as between the control group and treatment group (2) in summer. No other significant differences ($p<0.05$) were encountered.

3.2.5.3: Occurrence of first postpartum oestrus:

In Figure (23) the averages days recorded for occurrence of first postpartum oestrus in the control group and treatment groups (1), (2) and (3) were 61.3±22.2 days, 46.7±17.2 days, 56.4±20.9 days and 45.7±23.9 days, respectively, in summer, while they were 52.7±27.3 days, 49.2±24.2 days, 51.5±29.1 and 40.7±12.6 days, respectively, in autumn. The four groups recorded 49.4±22.3 days, 40.6±16.6 days, 46.0±24.0 days and 41.4±11.3 days, respectively, in winter.

A weak significant difference ($p\leq0.05$) was observed between the control group and the treatment group (3) in autumn, while there were no other significant differences ($p\leq0.05$) recorded between the remainder groups

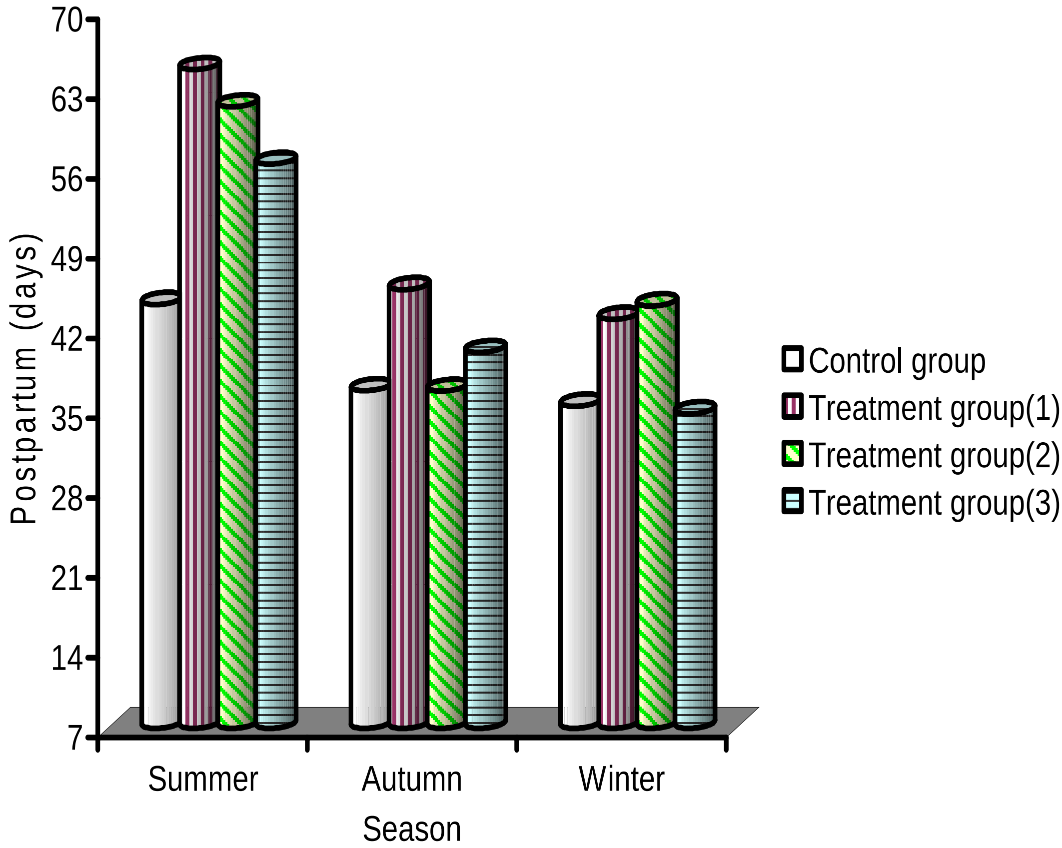

Figure 22. Effect of season on the first postpartum ovarian activity in the control group (C) and the treatment groups (1), (2) and (3).

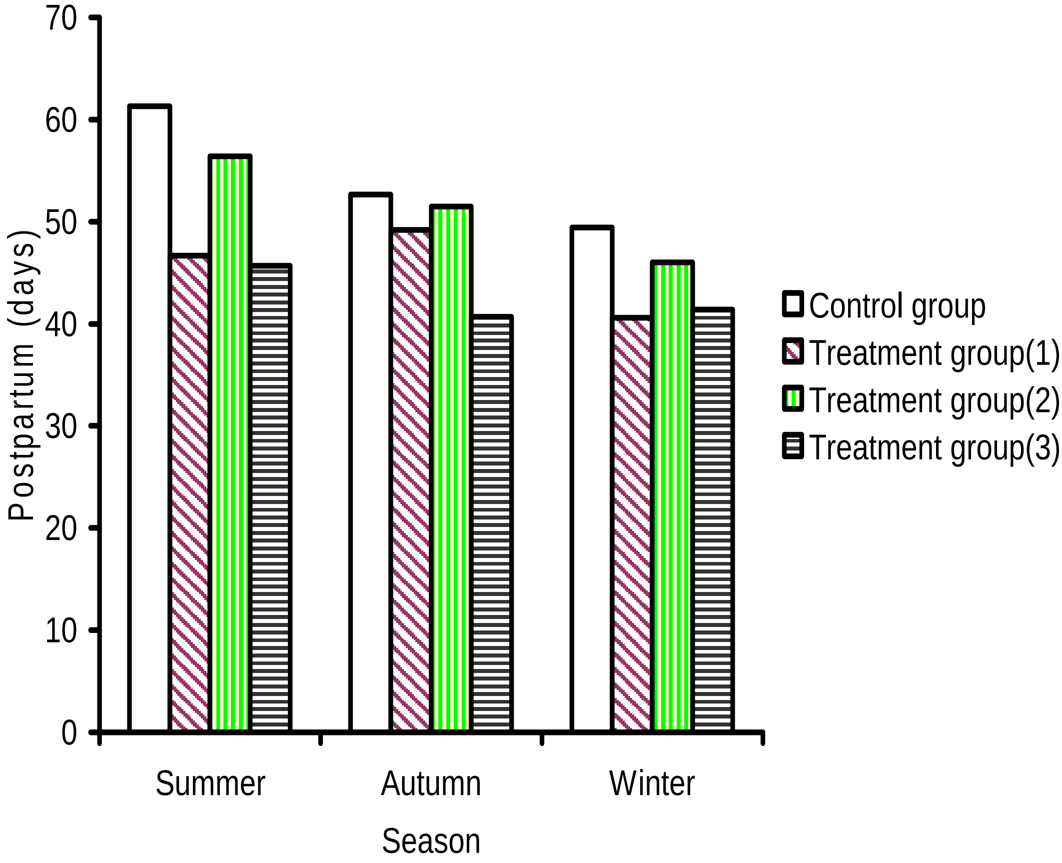

Figure 23. Effect of season on the occurrence of the first postpartum oestrus in the control group (C) and the treatment groups (1), (2) and (3).

3.2.5.4: Number of services per conception:

As shown in Figure (24) the averages of number of services per conception in the control group and the treatment groups (1), (2) and (3) were 3.5±1.4, 4.1±2.2, 3.3±1.4 and 3.7±1.6, respectively, in summer, and 3.0±2.1, 3.7±1.7, 3.2±2.0 and 2.4±1.5, respectively, in autumn .The four groups achieved 2.7± 2.0, 2.8±1.4, 2.8±1.8 and 2.7±1.2, respectively, in winter.

A weak significant difference ($p<0.05$) was counted between the treatment groups (1) and (3) in autumn, while no significant differences ($p\leq0.05$) were computed between the remainder groups.

3.2.5.5: Open period:

Figure (25) shows that the averages days open in the control and the treatment groups (1), (2) and (3) were 122.1±27.3 days, 136.6±29.4 days, 121.0±26.3 days and 114.6±20.23 days , respectively, in summer. They recorded 113.7±31.3 days, 115.8±35.3 days, 114.6±28.5 days and 93.6±28.5 days, respectively, in autumn, while, the four groups recorded 112.8±36.1 days, 105.4±34.3 days, 113.4±26.4 days and 94.7±16.2 days, respectively, in winter.

Weak statistical significant differences ($p<0.05$) were computed between the treatment group (3) and both the control group and treatment groups (1) and (2) in autumn, besides between the treatment groups (1) and (3) in summer, and between the control group and the treatment group (3) in both winter and autumn. No statistical significant differences ($p\leq0.05$) were existed between the other groups.

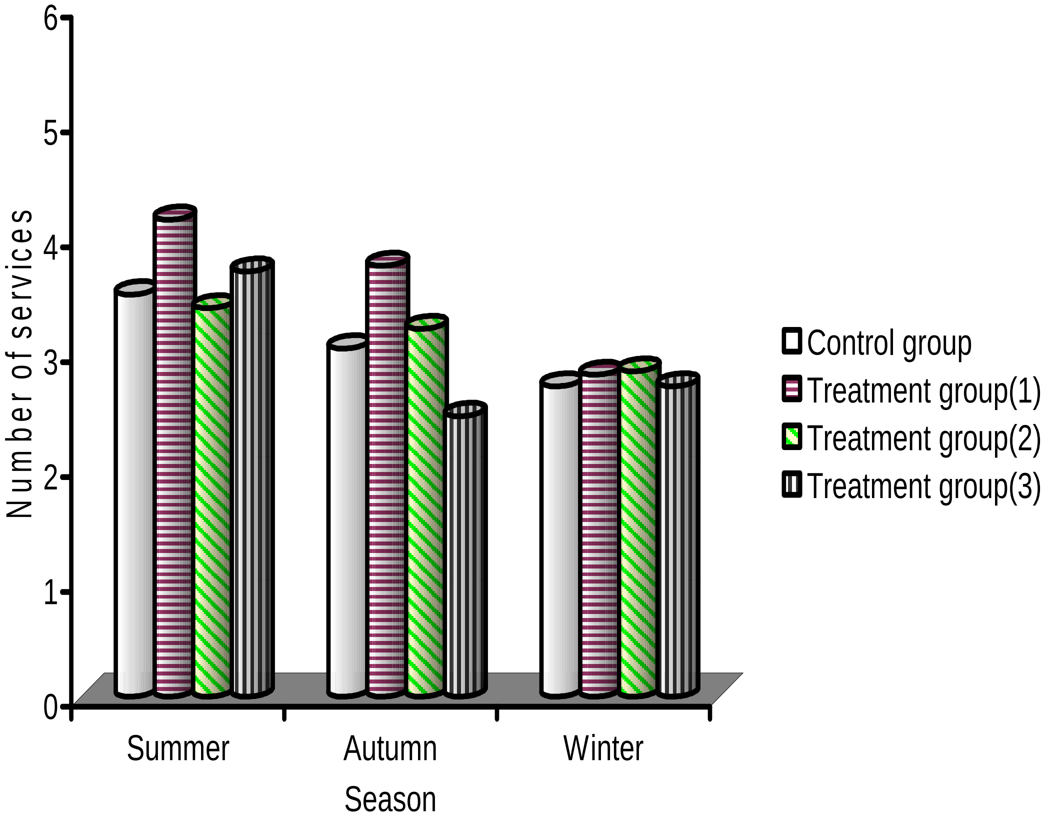

Figure 24. Effect of season on number of services per conception in the control group (C) and the treatment groups (1),(2) and (3).

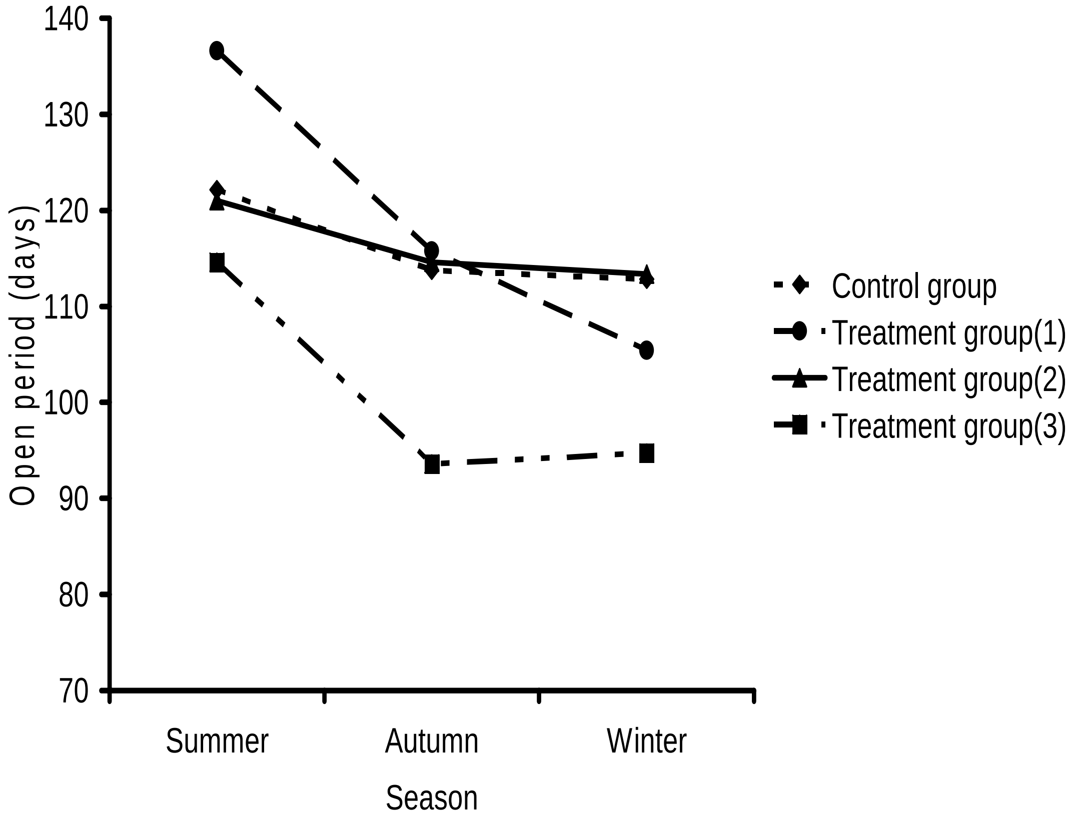

Figure 25. Effect of season on open period in the control group (C) and the treatment groups (1), (2) and (3).

Chapter four (4)

Discussion

Incidence of retained placenta:

In this study the incidence of retained placenta regarding animals' age, revealed an increasing pattern from 24 percent in heifers at ≤ 4 years of age to 40 percent in cows between 5 to 12 years, from the total number of cases observed. This result confirmed the influence of age on retained placenta incidences and this agreed with the finding of Hidson (1976).

Calving season was also found to be associated with incidence of retained placenta in this study. In summer 71 percent from total summer calvings demonstrated retention of foetal membranes, this result agreed with that of Joosten et al., (1991); Markusfeld (1984); Hidson (1976), the two former authors reported that calvings during summer have been associated with higher incidence of retained placenta while the latter author pinpointed heat stress as a direct factor.

Chassagne et al., (1996) observed a decreased incidence of retained placenta in autumn. Differences in temperatures or management environments in different countries or regions may account for these variations.

Manual removal of retained placenta:

Our results revealed that manual removal of retained placenta were successfully complete in 74.4 percent of cases and partial in 15.8 percent, while 9.8 percent were difficult to extract at all. These results slightly and considerably disagreed with some available literature. Its slightly disagreed with Dyrenddahl et al., (1977) who claimed complete removal of the placenta in 62 percent of cases, partly in 27 percent of cases and hardly to remove in 11 percent, and considerably disagree with Krizanec et al., (2003) who reported that 37.01 percent of cases have been totally removed, 55.76 of cases partially removed and 7.21 were difficult to remove. These variant attitudes were due to the different categorization used to classify the degree of membranes being extracted and the remaining part such as on the tip of the horns and some caruncles.

Postpartum reproductive traits:

In this study average of each postpartum reproductive trait is discussed under the influence of the subsequent postpartum related factors such as age, parity, body weight, foreign blood percentage and season. Therapeutic agent used in this study included; intrauterine Tetracycline pessaries, Oxytetyracycline intramuscular injection and ($PGF_{2}\alpha$) analogue (Cloprostenol) as intramuscular injection. The myometrium responded differently towards each therapy and in away or another affected the reproductive traits.

Uterine involution:

The over all average period achieved for complete uterine involution process in the control group was 29.44±7.93 days while treatment groups (1), (2) and (3) recorded 25.12±7.25 days, 22.65±8.04 days and 23.19±4.78 days, respectively. These results agreed with that of Kiracofe (1980) and Arthur et al., (1998), the first author reported that uterine involution is concluded around 45 days postpartum and consists of the reduction in size, loss of tissue, and tissue regeneration of the uterus. Arthur et al., (1998) found that uterus returned to its pregravid size within 3-7 weeks. Reduction in size is a response of myometrial contractility plays a major role in cleaning lochial debris from the uterus after calving (Slama et al., 1991; Hirsbrunner et al., 2002). Normal myoelectrical activity of the uterus is greater at calving and decreases drastically around 7 to 9 days postpartum (Gajewski and Faundez, 1992 ; Gajewski et al., 1999). Tetracycline intrauterine pessaries are used in this study as a broad spectrum bacteriostatic substance against Gram-positive and Gram-negative organism, Chlamydiae and Rickettsiae. Any resistance to it is due to reduced intracellular penetration as a result of modified membrane permeability. The direct intrauterine administration of Tetracycline produces immediate therapeutic concentrations, and because of their low absorption into blood stream their therapeutic action is largely confined to the uterine lumen and endometrium. Tetracyclines are known to be active in anaerobic conditions and are only partly inactivated by purulent material, blood, cell debris, and pH levels found in uterus with retained placenta. Hereby treatment group (1) revealed a faster uterine involution process compared to that of the control group, after manual extraction and care. This result disagreed with Bretzlalff (1982) and Paisley et al., (1986). The latter found that intrauterine Tetracycline do not consistently improve the bacteriology and fertility of cows with retained placenta while Roberts (1986) claimed that the main effect of intrauterine pessaries is to reduce putrefaction, which would lessen odour but could prolong retention of the placenta. Besides intrauterine Tetracycline, using Oxytetracycline injection improve uterine healing because it is primarily a bacteriostatic drug and ready to be bound to plasma proteins in varying degrees, consequently this activity enable the drug to reach most infected tissue in the animal's body including the uterus. However, its role on uterine involution process is unidentified. As known ($PGF_{2\alpha}$) is responsible for uterine involution after parturition and greater postpartum ($PGF_{2\alpha}$) concentration is associated with faster uterine involution, in this study a single intramuscular injection of 2ml (500 μg) ($PGF_{2\alpha}$) analogue (Cloprostenol) was administered immediately intramuscular after manual extraction of retained placenta at the 3rd day postpartum in treatment group (2), and at 14 days postpartum in treatment group (3). These two applications lead to strong uterine contractions because ($PGF_{2}\alpha$) is uterotonic substance so uterine myoelectrical activity was increased during the early postpartum period subsequently reduced the period required for uterine involution. Our data agreed with Gajewski et al., (1999). Therefore in treatment groups (2) and (3) complete uterine involution occurred 7.34 and 6.30 days earlier than the control group, and by 2.28 and 1.24 days, consecutively, in comparison with treatment group (1). Apparently the treatment groups' values are significantly lower than the control group. Despite the fact that metritis produces additional Prostaglandins, the uterine musculature does not respond to these endogenous Prostaglandins, and the involution process is delayed (Kindahl et al., 1999), the intervention in this study revealed an excellent results. There might be other mechanisms that play additional roles in uterine involution such as leukocyte function, cytokines, endotoxin response, and antibody production (Mateus et al., 2002- 2003). In contrast, other studies by Eiler et al., (1984) and Burton et al., (1987) did not find a positive effect of ($PGF_{2}\alpha$) injection on myometrial activity in dairy cows during the first 4 days postpartum.

In this study the effect of the season on uterine involution clearly observed. The longest period needed to reach complete uterine involution was recorded in summer and became shorter during autumn and winter. This observation was consistent in the four experiment groups. This is attributable to heat stress, which affected uterine involution process through variety of factors, and leads to energy imbalance and myometrium overstretching. The results disagreed with Roberts (1971) who reported that during the spring and summer month's cow's uteri involuted more rapidly than cow calving during autumn and winter months, this variation between results could be due to hereditary factors and difference in climatic zone.

Ovarian activity:

First postpartum ovarian activity was detected through rectal palpation when the cows' showed evidence of presence of normal corpus leutum. The over all average period recorded in the control group was 38.27±13.54 days while treatment groups (1), (2) and (3) attained 47.46±22.63 days, 44.28±23.58 days, 42.46±21.96 days, respectively. In control group the first detected corpus luteum was at the fifth to sixth weeks postpartum that agreed with Arthur et al., (1998) who reported that the duration of anoestrus ranged from 30 to 67.3 days. Also our data considerably agreed with that of Magda (2003) who stated that normal ovarian resumption in Northern Sudan cross bred dairy cows was 31.64±11.37 days. Treatment group (1) showed first postpartum ovarian activity 9.92 days latter than the control group. This delay is related to many factors affecting uterine involution including retained placenta. Treatment groups (2) and (3) delayed first postpartum ovarian activity by 5. 45 and 3.16 days, respectively, in compared with the control group while they were faster 3.47 and 6.76 days, respectively, when compared with treatment group (1). First-calf heifers, in this study had longer postpartum intervals than mature cows. This agreed with Bellows and Short (1978); and it is due to period of an ovulatory anoestrus which is observed in both milked and suckled cows following parturition (Darwash et al., 1997). However, feed intake and energy imbalance could play a major role. In this result cross bred dairy cows in the control and treatment groups had initiated ovarian cycles between 25 to 71 days after calving and there were no significant differences between the four experimental groups. This result agreed with that of Garverick (2004) and Stewart (1952) who concluded that cows could not come into oestrus till 28 days of parturition. It also conform with Bulman and Wood (1980) who found that dairy cows resumed normal cyclicity within 20 days postpartum and increased by 40 days while Fonseca et al., (1983); Stevenson and Call (1983); found that in dairy cattle the interval from calving to first ovulation is typically between 19 and 22 days postpartum . However the first ovulations detected by progesterone levels take place between 2-5 weeks postpartum (Fonseca et al., 1983; Larsson et al., 1984). Comparable findings were also observed by Sakaguchi et al., (2004) and reported that first postpartum ovulation was observed within 4 follicular waves, and the follicular wave patterns and ovarian cycles in most cows returned to normal after the second postpartum ovulation (in normal cows). The mechanisms that exogenous Prostaglandin could stimulate cow's ovaries after calving are not known although several speculations have been proposed. Seguin et al., (1983) found that ($PGF_{2\alpha}$) is luteolytic and its administration would result in the lysis of corpora lutea that developed early after calving. The use of ($PGF_{2\alpha}$) as a drug for treating retained placenta as a therapeutic agent has been extensively reviewed in both dairy and beef cows and was found to trigger lysis of mature lutea (Cooper, 1974-1975; Stotts, 1987; Godfrey, 1989; Plata, 1990). Cloprostenol therapy at early postpartum period resulted in a decreased plasma progesterone concentration which was directly and indirectly associated with a decrease in the calving to conception interval. The indirect effects were mediated by a reduction in days to first oestrus. When ($PGF_{2\alpha}$) was administered to cows with a functionally mature corpus luteum 85 % to 95 % reached oestrus within 7 days of treatment 70 %-90 % showed signs of oestrus 3 to 5 days after treatment (Lauderdale, 1974; Lee, 1983; Stevenson, 1994). There have been many reports of different intervals to oestrus and ovulation following Prostaglandin treatment. The time elapsed between ($PGF_{2\alpha}$) treatment and the onset of oestrus depends on the stage of oestrus cycle at the time of ($PGF2\alpha$) treatment. Kastelic and Ginther (1991) stated that the mean interval to oestrus was 48 to72 hour when ($PGF2\alpha$) was administered on oestrus cycle day 5 or day 8 in dairy cows. $PGF2\alpha$ administration in mid cycle day 8 to day 11 or latter in the luteal phase day 12 to 15 resulted in a mean time to oestrus of 72 and 62 hours, respectively. High progesterone levels at the time ($PGF2\alpha$) administration were associated with delayed onset of oestrus (Murugavel et al., 2000-2003). The stage of follicular wave development at the time of ($PGF2\alpha$) treatment appears to be the factor determining the time of oestrus onset. The time from ($PGF2\alpha$) administration to ovulation was dependent on the maturity and size of the most emergent dominant follicle, because a small dominant follicle takes longer to grow into ovulatory follicle. When dominant follicle had reached the static phase, the time from treatment to ovulation was 3 days, and if a new dominant follicle had emerged at the time of luteolysis, this time period increased to 4.5 days (Murugavel et al., 2000-2003). These variations in oestrus cycle was observed in this study in addition to delayed oestrus in cows experiencing problems at calving or are in a severe negative energy balance following calving. Energy balance is probably more important than other factors in delaying the beginning of heat cycles (Shearer and Webb, 1992).

Season of the year influences the duration of the first postpartum ovarian activity in both suckled and milked cows. In Northern Sudan, animals calving during summer have significantly longer intervals to first ovulation than those calving before or afterwards. This result agreed with Lamming et al., (1981); Fonseca et al., (1983) ; Opsomer et al., (2000a) who reported the same results in temperate cattle. Arthur et al., (1998) found that, cows in the tropical areas show a delay at postpartal ovarian activity compared with those in temperate zones. In autumn and winter, Khartoum cross bred dairy cows showed reduction in days to first postpartum ovarian activity.

Our results are close to Claus et al., (1983) who studied temperate cattle and found that spring calving significantly delays ovarian activity than autumn calving. These variations are attributed to energy balances and photoperiod which have a strong effect on cyclicity (Shearer, 1992).

Occurrence of first observable oestrus:

The over all average days achieved in the control group for exhibit of the first postpartum oestrus was 53.90±24.11 days while treatment groups (1), (2) and (3) attained 45.16±20.34 days, 48.84±25.46 days and 41.93±16.03 days, respectively. These results agreed with that of Garcia (1982) who stated that the mean interval from calving to first oestrus ranged from 33 to 85.5 days. Also Morrow (1966) reported that the duration of observable oestrus between different types of cattle was 30 to 76.3 days for dairy cows and 52.2 to 80.2 days for beef cows. Our data considerably agreed with that of Magda (2003). Moreover treatment group (1) showed earlier occurrence of first postpartum ovarian activity by 8.24 days than the control group. This is due to intrauterine Tetracycline and clinical followed-up program which accelerated uterine involution process and rapidly ease the exhibition of the first postpartum oestrus. Furthermore treatment groups (2) and (3) also reduced exhibit of first postpartum oestrus term by 4.24 and 13.11days, respectively, compared to the control group, they also showed earlier postpartum oestrus by 3.47 and 6.76 days, respectively, compared to treatment group (1). The difference between treatment group (2) and (3) was 8.87 days in favor to group (3). Using manual extraction for retained placenta and Cloprostenol injection after two weeks postpartum accelerated the exhibition of oestrus signs more than administration of Cloprostenol immediately after manual extraction. The former method directly resulted in a decreased calving to first observable oestrus interval. This study showed that first-calf heifers tended to show longer intervals between parturition and first observed oestrus than older cows over 5 years of age. This result agreed with that of Roberts (1971). A high incidence of silent heat was report during the postpartum period in first calvers. After three month parturition 93 percent of cows had shown visible signs of oestrus (Morrow et al., 1969). Observed estrum is difficult to detect because oestrous periods are usually about 10 hours in length but in some cattle especially heifer's estrum may be only 5 to 9 hours long (Roberts, 1971). King et al., (1976) observed that the first sign of oestrus was not always a true reflection of the onset of cyclicity.

In this study cross bred dairy cows exhibited oestrus signs earlier in autumn followed by winter then summer. Excessive heat over a long period may cause an oestrus. Gangwar et al., (1965) showed that when environmental temperature were maintained at 75 to 95 F the duration of the oestrus period was 11 hour compared to 20 hours in heifers. Under heat stress the intensity of oestrus signs where also reduced so that percentage of observed oestrus decreased.

Number of services per conception:

The over all average period achieved in the control group for number of services per conception was 3.05±2.13, while treatment groups (1), (2) and (3) attained 3.55± 1.81, 3.26±1.79 and 2.81±1.59, respectively. These results slightly agreed with that of Mageda (2003). In the field area it was noticed that, on average, the farmers allowed the cows a maximum of eight cycles to get pregnant. All groups are showed almost minimum number of services than that. Thus, the different treatment adopted during the early postpartum period revealed increase in pregnancy rate to first service in cows with normal or abnormal puerperium. Laven and Peters (1996) found that untreated retained placenta cows have longer calving to first service interval, more returns to first service and require more services per conception. Yet, the number of services per conception depends largely on the breeding system used. It is higher under uncontrolled natural breeding as in this study and low where hand-mating or artificial insemination is used (Laven and Peters, 1996). Our study reflects poor number of services per conception because it's greater than 2.0 as Choudhuri et al., (1984) estimated that repeatability of number of services per conception for Haryana cattle was significantly affected by herd, season, placenta expulsion time, lactation length and milk yield. Since heritability can be broadly estimated from repeatability, this study indicates that heritability is low and most of the variation in number of services per conception is attributable to environmental factors. This result agreed with El-Amin et al., (1981) who concluded that number of services per conception did not differ significantly between Red Butana and Red Butana crosses but was influenced by month of calving. Number of services per conception increased over the study period, probably due to changes in management. Furthermore, the study agreed with Sharma and Bhatnagar (1975) who found a significant effect of parity on number of services per conception in Sahiwal, Red Sindhi and Tharparkar cattle. The number of services per conception was highest at the fourth lactation. Kumar and Bhat (1979) noted that Haryana heifers needed more services per conception than cows. Tegegn et al., (1981), in Ethiopia found that number of services per conception was lower for animals from wet areas than for those from drier areas (1.74±0.6 vs. 1.98±0.07). Crossbred cows required 0.12 and 0.14 fewer services per conception than local Zebu cows in wet and dry areas, respectively.

In our data no absolute evidence of seasonal effect on the number of services per conception in the different experimental groups. The absence of seasonal effects on number of service was reported by Mekonnen and Goshu (1987) and Asseged and Birhanu (2004). The reason for the apparently poor fertility in all season of the year needs to be investigated. Earlier analyses carried out by Mohamed et al., (1985) indicated that fewer services were required per conception in the dry summer than in the other season. This finding is consistent with the higher total number of conceptions in the dry summer.

Days open:

Days open is defined as the interval from calving to the time of successful breeding and is made up of three major components; the first one is an elective-waiting period, it is partly a managerial. The second one is the time between the end of the elective-waiting period and the detection of first oestrus, which means it is a function of the heat detection rate. The third component is the active breeding period and represents the number of days required for the cow to conceive after the first service. If a cow conceives at the first service, then the third component is nonexistent. Otherwise, this component is a function of the heat detection rate and the level of herd fertility (Peters, 1999). Our data for evaluating days open are calculated as date of pregnancy minus previous calving date. The over all average days achieved in the control group was 115.39±22.98 days while treatment groups (1), (2) and (3) attained 114.99±34.78 days, 114.51±28.33 days and 98.68±25.00 days, respectively. The control group and treatment groups (1) and (2) showed extended open period, while the third treatment group recorded the shorter one. Murugavel et al., (2000-2003) affirmed that ($PGF_{2}\alpha$) treatment during the early postpartum period produced reduction in days open .These results are widely agreed with Câzares et al., (1993) who found that suckling Brown Swiss x Zebu cows had reduced open period compared to local cattle. Also Arthur et al., (1998) recorded calving to conception interval of 98 days for those with delayed ovarian activity, 102 days for those with persistent luteal function, and 124 days for those cows where there was cessation of cyclical activity compared with 85 days for normal cows .However, our study disagreed with that of Magda (2003) who reported an open period of 156.69±85.12 days for normal Northern Sudan cross bred dairy cows. Peters (1999) considered the average days open as a tool for assessment of the reproductive efficiency in a herd. Use of pregnancy diagnosis improved the accuracy to predict days open average. A dairy herd with a reasonable high standard of fertility has a calving to conception interval of less than 95 days (Peters, 1999).

Our data showed no significant relationships between days open and the three season even after (PGF2α) administration. Eventually no differences were detected in fertility measures between primiparous and multiparous cows.

Conclusion and recommendations:

1- Manual extraction is still the most common practical method for treating retained placenta in Khartoum State. Nevertheless, many veterinarians have allegations against it without proving the accuracy of the method or find a new solution. Close supervision for retained placenta cases is the key role to reduce many unfavorable reproductive consequences and economic loss.

2- PGF2α analogues (Cloprostenol) single dose injection on day 3 or day14 postpartum showed some positive reproductive effect compared with retained placenta traditional practices, increased pregnancy rate and decreased reproductive costs by shortening the days interval. As currently, field studies are being conducted to examine the potential of various heat detection methods in conjunction with (PGF2α) to further improve to overall herd reproductive performance and reduce costs, our study managed to evaluate further effect of ($PGF_{2\alpha}$) on treatment of retained placenta.

3- Rectal palpation is documented to be substantially imperfect test of ovarian status and luteal function. In spite of that; during our study period, rectal palpation based a concrete evidence of cyclicity which presents either a palpable corpus leutum or follicle as the dominant ovarian structure, and was associated with increase in pregnancy rate relative to cows with no palpable structures.

4- Our study depended on a few references focused on using synthetic ($PGF_{2\alpha}$) in retained placenta treatment, such important field information should be recognized in the future. Therefore, the recommended practice from this study is that of treatment group (3), which included the combination of manual removal, Tetracycline intrauterine pessaries, Oxytetracycline injection and ($PGF_{2\alpha}$) analogue injection at day 14 postpartum.

5- The suggestion grew up from the study is that cows should be in a good body condition at calving and dry-matter intake should maximized as soon as possible after calving.

Finally despite of many years of retained placenta research, it remains poorly understood and further study and investigation must be carried on firmly because it demolishing fertility and economic of many farms in Khartoum State mainly in East Nile areas which appeared annually as an endemic and herds problem.

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Appendix 1. Effect of age on postpartum traits in the control group cross bred dairy cows (X±STDEV)

Age ranges (Years)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
2-4	28	25.80 a ± 7.10	37.90 c ± 12.80	50.60 b ± 23.20	3.29 b ± 2.00	118.40 b ± 31.50
5-6	20	28.70 c ± 8.50	37.70 c ± 12.30	59.10 a ± 23.00	4.00 a ± 2.30	120.00 b ± 32.70
7-8	15	30.60 b ± 8.00	34.80 a ± 7.43	53.80 b ± 24.70	3.01 b ± 1.50	104.90 a ± 31.40
9-11	12	32.10 a ± 11.30	42.00 b ± 21.30	52.70 b ± 30.60	3.00 b ± 2.30	113.80 b ± 37.10
Overall	٧٥	28.60 ± 8.60	37.80 ± 13.40	53.90 ± 24.50	3.30 ± 2.10	115.30 ± 32.50

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).

Appendix 2. Effect of age on postpartum traits in the treatment group 1 (G1)

(X±STDEV)

Age ranges (Years)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
2-4	١٩	21.74 b ± 6.68	39.42 a ± 10.76	38.37 b ± 21.28	4.00 b ± 1.00	107.00 c ± 12.54
5-6	١٠	26.70 b ± 7.00	39.50 a ± 11.50	42.80 c ± 16.51	3.48 a ± 1.50	98.30 b ± 34.60
7-8	١٦	24.06 c ± 6.24	46.13 c ± 17.80	43.81 c ± 22.01	4.02 b ± 2.00	122.70 b ± 34.29
9-11	١١	30.10 a ± 5.80	56.60 a ± 28.00	51.40 a ± 10.91	4.50 a ± 2.00	134.20 a ± 28.11
Overall	٥٦	24.50 ± 7.05	44.64 ± 19.23	42.55 ± 16.01	4.00 ± 1.70	112.81 ± 34.13

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).

Appendix 3. Effect of age on postpartum traits in the treatment group 2 (G2)

(X±STDEV)

Age ranges (Years)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
2-4	23	20.30 a + - ٨,٤٦	٤٦,٣٠ c + - ٢٥,٣٧	51.80 b + - 29.62	3.60 a + - 2.00	106.55 b + - 37.57
5-6	8	22.17 b + - ٨,٢٠	34.67 a + - ١٠,٢٣	48.67 b + - 6.03	4.00 a + - 2.16	106.50 b + - 24.94
7-8	8	22.16 b + - ٨,٧٧	37.00 a + - ١٦,١١	43.00 a + - 8.80	4.40 a + - 1.51	116.67 b + - 20.03
9-11	4	30.33 a + - ١٠,٧٠	59.33 b + - ٢٤,٣٣	48.00 b + - 14.93	3.70 a + - 1.53	121.00 a + - 16.52
Overall	43	24.50 + - 7.04	44.63 + - 24.82	49.19 + - 26.45	3.91 + - 1.82	110.00 + - 31.16

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).

Appendix 4. Effect of age on postpartum traits in the treatment group 3 (G3)

(X±STDEV)

Age ranges (Years)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
2-4	9	22.40 b + - 5.52	39.80 c + - ٢٠,٦٤	34.70 a + - ١٤,٤٥	3.90 a + - 1.80	109.40 b + - ٢٦,٨٥
5-6	4	17.50 a + - 4.04	31.25 a + - ٦,٩٠	35.25 a + - ١٧,٢٠	2.05 a + - ١,٤٠	82.25 a + - ٨,٣٨
7 -8	12	23.70 b + - 3.54	40.15 c + - ١٨,٠٠	42.85 b + - ١٥,٠٥	3.70 a + - ١,٦١	98.00 d + - ٣٢,١٧
9-11	13	24.23 b + - ٤,٦٢	48.50 b + - ٢٨,٣٢	49.23 b + - ١٨,٠٠	3.03 b + - ١,٦٠	93.00 c + - ١٨,٣٠
Overall	38	٢٣,٠٠ + - ٤,٧٥	٤٢,٠٠ + - ٢١,٧٢	٤٢,٠٠ + - ١٦,٣٢	٣,١٧ + - ١,٦٠	٩٧,٢٣ + - ٢٥,٥٠

(X±STDEV)- Data are means±standard deviation.
a, b, c and d different superscript letters within a column indicates a statistically significant difference (P≤0.05).

Appendix 5. Effect of age on postpartum traits in the control and the treatment groups cross bred dairy cows - Overall summary of means (X±STDEV)

Traits	Control group n=75	Treatment retained placenta group(1) n=56	Treatment retained placenta group(2) n=43	Treatment retained placenta group(3) n=38
Uterine involution process (days)	28.60 + - 8.60	٢٤,٥٠ + - ٧,٠٥	٢٤,٥٠ + - ٧,٠٤	٢٣,٠٠ + - ٤,٧٥
First ovarian activity (day)	37.80 + - 13.40	٤٤,٦٤ + - ١٩,٢٣	٤٤,٦٣ + - ٢٤,٨٢	٤٢,٠٠ + - ٢١,٧٢
Occurrence of first postpartum oestrus (day)	53.90 + - 24.50	٤٢,٥٥ + - ١٨,٠٧	٤٩,١٩ + - ٢٦,٤٥	٤٢,٠٠ + - ١٦,٣٢
Number of services per conception	3.30 + - 2.10	٤,٠٠ + - ١,٧٠	٣,٩١ + - ١,٨٢	٣,١٧ + - ١,٦٠
Open period (days)	١١٥,٣٠ + - ٣٢,٥٠	١١٢,٨١ + - ٣٤,٣٠	١١٠,٠٠ + - ٣١,١٦	٩٧,٢٣ + - ٢٥,٥٠

(X±STDEV)- Data are means±standard deviation.
n -Number of animals.

Appendix 6. Effect of age on postpartum traits in the control and the treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	131	١١٦	١١١	٩٧	٩٢	٧٩
Uterine involution process (days)	٢,٩٩ **	٢,٨٠ **	٤,٤٦ **	٠,٠٠ Ns	١,٢٣ Ns	١,١٤ Ns
First ovarian activity (day)	٢,٢٨ *	1.67 Ns	١,٠٩ Ns	٠,٠٠ Ns	٠,٦١ Ns	٠,٥١ Ns
Occurrence of first postpartum oestrus (day)	3.05 **	٠,٩٦ Ns	٣,٠٧ **	١,٤٠ Ns	٠,١٥ Ns	١,٤٩ Ns
Number of services per conception	2.10 *	1.66 Ns	٠,٣٦ Ns	٠,٢٥ Ns	٢,٤٠ *	١,٩٥ Ns
Open period (days)	٠,٤٢ Ns	٠,٨٨ Ns	٣,٢٤ **	0.43 Ns	2.53 *	2.03 *

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 7. Effect of parity on postpartum traits in the control group cross bred dairy cows (X±STDEV)

Parity ranges (Calvings)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
1-3	٤٧	27.00 b + - ٨,٠٠	38.00 c + - ١٢,٣٦	54.36 c + - ٢٣,٤٥	3.20 b + - ٢,٠٠	116.10 d + - ٣٢,٢٥
4-5	١٧	31.10 c + - ٧,٦٨	36.16 b + - ١٠,٠٤	54.61 c + - ٢٧,٠٠	2.65 a + - ١,٥٠	113.56 c + - ٢٧,٣٨
6-7	١٢	30.17 c + - ١٠,٧١	34.92 b + - ١٣,٢١	42.83 a + - ١٧,٤٧	2.75 b + - ٢,٠٠	107.00 b + - ٣٤,٥٣
8-9	٨	40.25 a + - ٤,٠٠	55.13 a + - ١٩,٤١	69.38 a + - ٢٩,٣٦	3.40 b + - ٢,٥٠	144.00 a + - ٣٣,١٣
Overall	٨٤	٢٩,٥٤ + - ٨,٨٠	٣٨,٧٢ + - ١٣,٦٩	٥٤,٢٠ + - ٢٤,٤٨	٣,٠٠ + - ٢,٠٠	١١٧,٠٠ + - ٣٢,٥٦

(X±STDEV)- Data are means±standard deviation.
a, b, c and d different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 8. Effect of parity on postpartum traits in the treatment group (1) (G1)

(X±STDEV)

Parity ranges (Calvings)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
1-3	٣١	23.96 b ± ٧,٤٨	39.32 b ± ١٣,٠١	42.53 b ± ١٧,٣٨	2.85 a ± ١,٥٢	103.96 b ± ٣١,٢٧
4-5	١٥	24.73 b ± ٦,٩٣	44.00 c ± ١١,٥٣	42.13 b ± ١٩,٦٦	3.30 b ± ١,٩٥	120.47 c ± ٢٨,٥٣
6-7	١٠	28.70 a ± ٦,١٣	61.00 b ± ٢٩,٦١	48.40 b ± ١١,٣٦	3.50 b ± ١,٩٠	126.30 b ± ٣٨١٦
8-9	٦	29.60 a ± ٥,٢٧	79.83 a ± ٣٣,٥٣	71.83 a ± ٣٥,٩٤	4.65 a ± ١,٥١	142.00 a ± ٣٥,٣٧
Overall	٦٢	٢٥,٤١ ± ٧,١٤	٤٧,٨٧ ± ٢٢,٤٦	٤٦,١٢ ± ٢٠,٩٥	٣,٥٦ ± ١,٧٣	١١٥,٢٤ ± ٣٣,٨٦

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistically significant difference (P≤0.05).

Appendix 9. Effect of parity on postpartum traits in the treatment group 2 (G2)

(X±STDEV)

Parity ranges (Calvings)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
1-3	٢٧	19.70 b + - ٧,٥٣	45.20 c + - ٢١,٥١	50.81 b + - ٣٠,١١	2.82 b + - ١,٨٤	114.00 b + - ٣١,٧١
4-5	١٢	24.50 b + - ٨,٧٠	37.17 b + - ١٩,٣٠	41.25 a + - ١١,٥١	3.70 a + - ١,٨٠	120.42 a + - ٢٠,٤٥
6-7	٣	21.00 c + - ٠٠,٠٠	40.00 b + - ٢٤,٤٠	54.40 b + - ٣٠,٦٠	3.00 b + - ١,٥٠	121.70 a + - ٤٥,١٠
8-9	٢	35.00 a + - ١,٠٠	67.50 c + - 24.25	53.50 b + - ١٦,٢٦	2.50 b + - ٢,١٢	120.50 a + - ٢٣,٣٣
Overall	٤٤	٢١,٨٠ + - ٨,٣٠	٤٣,٦٦ + - ٢٢,٤٠	٤٨,٦٠ + - ٢٥,٦٠	٣,٠٥ + - ١,٨٠	١١٦,٥٠ + - ٢٧,١٩

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 10. Effect of parity on postpartum traits in the treatment group 3 (G3)

(X±STDEV)

Parity ranges (Calvings)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
1-3	١٣	21.00 b + - ٥,٧٢	37.23 b + - ١٨,٦٦	34.00 a + - ١٤,٨٠	2.65 b + - ١,٥٠	103.15 a + - ٢٦,٤٤
4-5	١٠	23.10 b + - ٣,٣٨	31.90 a + - ٧,٠٠	40.50 b + - ١١,٣٦	2.30 b + - ١,٩٣	99.00 b + - ٢٤,٠٢
6-7	٩	23.33 b + - ٣,٥٠	54.33 a + - ٣١,٠٢	51.44 a + - ٢٠,٩١	2.20 b + - ١,٨٠	88.11 a + - ٣٤,٠٠
8-9	٧	25.00 a + - ٥,٥١	50.14 b + - ٢٢,٧٦	45.86 b + - ١٥,٤٧	3.00 a + - ١,٥٠	98.00 b + - ٢٢,٢٦
Overall	٣٩	٢٢,٨٠ + - ٤,٧٤	٤٢,١٣ + - ٢٢,١١	٤١,٨٢ + - ١٦,٦٤	٢,٥٠ + - ١,٦٥	٩٧,٨٥ + - ٢٦,٦٧

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 11. Effect of parity on postpartum traits in the control and the treatment groups cross bred dairy cows- Overall summary of means (X±STDEV)

Traits	Control group n=84	Treatment retained placenta group(1) n=62	Treatment retained placenta group(2) n=44	Treatment retained placenta group(3) n=39
Uterine involution process (days)	29.54 ± 8.80	٢٥,٤١ ± ٧,١٤	٢١,٨٠ ± ٨,٣٠	٢٢,٨٠ ± ٤,٧٤
First ovarian activity (day)	38.72 ± 13.69	٤٨,٠٠ ± ٢٢,٤٦	٤٣,٦٦ ± ٢٢,٤٠	٤٢,١٣ ± ٢٢,٢١
Occurrence of first postpartum oestrus (day)	54.20 ± 24.50	٤٦,١٢ ± ٢١,٠٠	٤٩,١٩ ± ٢٥,٦٠	41.82 ± ١٦,٦٤
Number of services per conception	3.00 ± 2.00	٣,٥٦ ± ١,٧٣	٣,٠٥ ± ١,٨٠	٢,٥٠ ± ١,٦٥
Open period (days)	١١٧,٠٠ ± ٣٢,٥٦	١١٥,٢٤ ± ٣٣,٧٦	١١٦,٥٠ ± ٢٧,١٩	٩٧,٨٥ ± ٢٦,٦٧

(X±STDEV)- Data are means±standard deviation.
n -Number of animals.

Appendix 12. Effect of parity on postpartum traits in the control and the treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	١٤٦	١٢٨	١٢١	١٠٤	٩٩	٨١
Uterine involution process (days)	3.15 **	٤,٩١ **	٥,٣٤ **	٢,٣٣ *	٢,٢٠ *	٠,٦٨ Ns
First ovarian activity (day)	٢,٨٨ **	١,٣٤ Ns	٠,٨٩ Ns	٠,٩٨ Ns	١,٢٩ Ns	٠,٣١ Ns
Occurrence of first postpartum oestrus (day)	٢,١٤ *	١,٠٧ Ns	٣,٢٣ **	٠,٦٥ Ns	١,١٤ Ns	١,٥٧ Ns
Number of services per conception	١,٨١ Ns	0.14 Ns	0.37 Ns	١,٤٦ Ns	٢,٣٢ *	١,١٤ Ns
Open period (days)	٠,٣٢ Ns	٠,٠٩ Ns	٣,٥٥ **	٠,٢١ Ns	٢,٨٧ **	3.15 **

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 13. Effect of body weight on postpartum traits in the control group cross bred dairy cows (X±STDEV)

Body weight ranges (kg)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
201-300	١٥	27.53 b + - 6.20	39.67 a + - 12.19	61.53 a + - 29.50	2.15 a + - 1.00	115.26 b + - 26.50
301-400	38	26.53 a + - 8.32	37.00 a + - 11.48	54.21 c + - 24.31	3.30 a + - 2.21	119.68 a + - 32.70
401-500	18	33.83 a + - 8.73	39.11 a + - 18.29	48.67 a + - 28.00	2.00 a + - 2.00	110.61 a + - 34.40
501-600	7	32.00 b + - 10.00	39.14 a + - 15.23	49.43 a + - 24.30	3.25 b + - 2.60	111.43 b + - 38.10
Overall	٧٨	29.00 + - 8.61	38.14 + - 13.60	54.00 + - 26.00	2.67 + - 1.90	113.44 + - 35.50

(X±STDEV)- Data are means±standard deviation.
kg –Kilogram.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 14. Effect of body weight on postpartum traits in the treatment group 1 (G1) (X±STDEV)

Body weight ranges (kg)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
201-300	11	26.73 b ± 7.60	34.90 a ± ٨,٠٠	43.10 b ± ١٢,٣٤	3.69 b ± 1.81	113.36 b ± 34.00
301-400	23	21.91 a ± 5.30	42.56 c ± ١٨,٢٩	٤١,٨٠ a ± ١٦,٧٠	3.46 b ± 1.64	113.21 b ± 41.44
401-500	21	24.84 b ± 6.90	٥٥,٧٦ b ± ٢٦,٤١	٤٤,٠٠ b ± ٢٤,٢٧	2.37 a ± 1.90	122.14 a ± 37.31
501-600	6	28.00 b ± 9.60	٧١,٨٣ a ± ٢٩,٨٤	٦٠,٣٣ a ± ٣٤,٥٣	3.97 b ± 1.80	107.83 a ± 32.71
Overall	62	25.14 ± 7.08	٤٨,٦٣ ± ٢٣,٧٤	٤٤,٦٠ ± 21.24	3.37 ± 1.80	115.80 ± 37.41

(X±STDEV)- Data are means±standard deviation.
kg –Kilogram.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 15. Effect of body weight on postpartum traits in the treatment group 2

(G2) (X±STDEV)

Body weight ranges (kg)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
201-300	12	18.67 a ± 7.51	36.91 a ± 13.60	53.83 b ± 33.01	2.91 a ± 1.62	116.75 c ± 28.00
301-400	16	23.63 b ± 7.61	51.50 a ± 25.30	51.25 b ± 27.57	3.00 a ± 1.80	113.80 b ± 29.00
401-500	11	22.40 c ± 8.60	37.80 a ± 17.20	43.90 a ± 17.00	3.00 a ± 2.00	113.20 b ± 31.46
501-600	5	26.00 b ± 11.50	48.00 a ± 41.61	45.00 b ± 16.90	3.50 a ± 1.60	125.60 a ± 15.77
Overall	44	22.30 ± 8.40	43.83 ± ٢٣,٧٤	49.81 ± 25.78	3.10 ± 1.73	116.00 ± 27.47

(X±STDEV)- Data are means±standard deviation.
kg –Kilogram.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 16. Effect of body weight on postpartum traits in the treatment group 3 (G3) (X±STDEV)

Body weight ranges (kg)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
201-300	8	23.00 b ± 6.67	43.00 b ± 24.15	40.00 b ± 17.33	3.50 a ± 1.60	117.71 a ± 23.80
301-400	13	22.50 a ± 4.19	38.29 a ± 17.80	35.80 a ± 13.82	3.03 a ± 1.90	91.21 a ± 18.73
401-500	14	23.00 b ± 4.28	46.00 a ± 28.37	47.80 a ± 19.00	2.90 a ± 1.50	97.00 b ± 21.34
501-600	5	26.60 a ± 6.00	44.40 b ± 14.03	41.00 b ± 3.74	3.43 a ± 1.00	113.60 a ± 15.60
Overall	44	23.90 ± 4.84	42.69 ± 22.30	41.50 ± 15.10	3.21 ± 1.51	101.40 ± 21.00

(X±STDEV)- Data are means±standard deviation.
kg –Kilogram.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 17. Effect of body weight on postpartum traits in the control and the treatment groups cross bred dairy cows- Overall summary of means (X±STDEV)

Traits	Control group n=78	Treatment retained placenta group(1) n=62	Treatment retained placenta group(2) n=44	Treatment retained placenta group(3) n=40
Uterine involution process (days)	29.00 + - 8.61	25.14 + - 7.08	22.30 + - 8.40	23.96 + - 4.84
First ovarian activity (day)	38.14 + - 13.60	٤٨,٦٣ + - ٢٣,٧٤	43.83 + - ٢٣,٧٤	42.69 + - 22.30
Occurrence of first postpartum oestrus (day)	54.00 + - 26.00	٤٤,٦٠ + - 21.24	49.81 + - 25.78	41.50 + - 15.10
Number of services per conception	2.67 + - 1.90	3.37 + - 1.80	3.10 + - 1.73	3.21 + - 1.51
Open period (days)	113.44 + - 35.00	115.80 + - 37.41	116.00 + - 27.47	101.40 + - 21.00

(X±STDEV)- Data are means±standard deviation.
n -Number of animals.

Appendix 18. Effect of body weight on postpartum traits in the control and treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	138	120	116	104	100	80
Uterine involution process (days)	٢,٩١ **	4.19 **	4.07 **	1.83 Ns	1.00 Ns	1.12 Ns
First ovarian activity (day)	٣,٠٩ **	1.47 Ns	1.18 Ns	1.03 Ns	1.28 Ns	0.22 Ns
Occurrence of first postpartum oestrus (day)	٢,٣٥ *	0.86 Ns	3.30 **	1.10 Ns	0.86 Ns	1.82 Ns
Number of services per conception	٢,٢٣ *	1.27 Ns	1.68 Ns	0.78 Ns	0.48 Ns	0.31 Ns
Open period (days)	0.38 Ns	0.45 Ns	٢,٣٣ *	٠,٠٣ Ns	٢,٤٨ *	٢,٧٥ **

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 19. Effect of foreign blood percentage on postpartum traits in the control group cross bred dairy cows (X±STDEV)

Foreign blood percentage ranges (percent)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
50-62.5	17	34.41 b + - 29.35	34.50 a + - 7.03	45.00 a + - 11.82	3.56 a + - 2.00	127.65 a + - 22.17
62.5-75	11	26.10 a + - 6.33	42.50 a + - 13.60	66.36 a + - 32.00	3.44 a + - 1.75	123.91 a + - 36.05
75-87.5	27	29.30 b + - 10.10	36.10 b + - 13.40	47.93 a + - 22.10	2.35 a + - 2.00	102.00 a + - 37.00
87.5-99.9	21	31.70 b + - 7.55	42.60 a + - 16.31	60.00 a + - 23.60	3.53a + - 2.50	117.81 b + - 26.04
Overall	76	30.63 + - 5.71	38.43 + - 13.45	53.50 + - 23.45	3.22 + - 2.01	115.28 + - 32.27

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 20. Effect of foreign blood percentage on postpartum traits in the treatment group 1 (G1) (X±STDEV)

Foreign blood percentage ranges (percent)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
50-62.5	18	25.70 b ± 6.80	43.11 a ± 18.16	48.05 b ± 21.17	3.20 b ± 1.70	121.83 a ± 34.33
62.5-75	8	28.00 a ± 7.50	49.50 b ± 20.29	54.38 a ± 21.16	4.27 a ± 2.15	110.90 a ± 48.90
75-87.5	19	24.40 b ± 8.43	50.70 b ± 28.56	47.72 b ± 24.46	2.41 a ± 1.80	109.00 a ± 32.54
87.5-99.9	16	25.00 b ± 6.91	48.18 b ± 23.50	39.38 a ± 16.80	3.34 b ± 2.00	119.81 b ± 29.56
Overall	63	25.41 ± 7.72	47.58 ± 22.80	47.38 ± 21.04	3.30 ± 2.00	116.12 ± 34.13

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 21. Effect of foreign blood percentage on postpartum traits in the treatment group 2 (G2) (X±STDEV)

Foreign blood percentage ranges (percent)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
50-62.5	10	19.60 a ± 8.00	40.80 b ± 15.14	49.30 a ± 26.05	2.20 a ± 1.40	101.10 a ± 26.83
62.5-75	6	24.50 b ± 10.26	48.50 b ± 30.03	44.67 a ± 24.81	3.50 b ± 2.30	111.00 b ± 21.43
75-87.5	14	22.00 b ± 8.62	51.42 b ± 31.46	47.00 a ± 26.04	3.14 b ± 2.50	118.30 b ± 29.65
87.5-99.9	12	22.75 b ± ٨.00	38.83 a ± 12.10	49.00 a ± 22.00	3.16 b ± 1.30	126.75 a ± 24.27
Overall	42	22.00 ± 8.41	45.00 ± 23.34	47.76 ± 24.00	3.00 ± 1.80	115.57 ± 31.16

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 22. Effect of foreign blood percentage on postpartum traits in the treatment group 3 (G3) (X±STDEV)

Foreign blood percentage ranges (percent)	Number of animals	Uterine involution process (days)	First ovarian activity (day)	Occurrence of first postpartum oestrus (day)	Number of services per conception	Open period (days)
50-62.5	9	21.80 b + - 6.50	45.80 a + - 30.16	42.44 b + - 23.80	3.00 a + - 1.35	108.60 a + - 26.23
62.5-75	6	22.40 b + - 3.13	43.40 a + - 26.51	37.80 a + - 19.42	2.20 b + - 1.50	97.60 c + - 22.01
75-87.5	12	21.58 a + - 3.60	40.83 a + - 16.84	43.50 b + - 12.65	2.00 b + - 2.15	102.42 b + - 25.81
87.5-99.9	13	25.00 a + - 4.3٤	42.33 a + - 18.61	43.00 b + - ١٣,٠٨	2.25 b + - ١,٥٠	88.20 a + - 28.50
Overall	40	23.04 + - 4.80	43.00 + - 21.70	42.40 + - 16.05	٢,٣٤ + - ١,٦٠	98.00 + - 26.82

(X±STDEV)- Data are means±standard deviation.
a, b and c different superscript letters within a column indicates a statistical significant difference (P≤0.05).

Appendix 23. Effect of foreign blood percentage on postpartum traits in the control and the treatment groups cross bred dairy cows- Overall summary of means (X±STDEV)

Traits	Control group n=76	Treatment retained placenta group(1) n=60	Treatment retained placenta group(2) n=42	Treatment retained placenta group(3) n=40
Uterine involution process (days)	30.63 ± 5.71	٢٥,٤١ ± 7.72	22.00 ± 8.41	23.04 ± 4.80
First ovarian activity (day)	43.83 ± 13.45	47.58 ± 22.80	45.00 ± 23.34	43.00 ± 21.70
Occurrence of first postpartum oestrus (day)	53.50 ± 24.45	46.48 ± 21.04	47.76 ± 24.00	42.40 ± 16.05
Number of services per conception	3.22 ± 2.01	3.30 ± 2.00	3.00 ± 1.80	2.34 ± ١,٦٠
Open period (days)	115.28 ± ٣٢,٢٧	116.12 ± 34.19	115.57 ± 27.28	98.00 ± 26.82

(X±STDEV)- Data are means±standard deviation.
n=Number of animals.

Appendix 24. Effect of foreign blood percentage on postpartum traits in the control and the treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	134	١٢٦	١٢٤	١٠٠	٩٨	٨٠
Uterine involution process (days)	٤,٣٨ **	5.94 **	7.57 **	2.08 *	١,٩٠ Ns	0.69 Ns
First postpartum ovarian activity (day)	1.13 Ns	0.30 Ns	0.22 Ns	0.56 Ns	1.01 Ns	0.40 Ns
Occurrence of first postpartum oestrus (day)	1.80 Ns	1.25 Ns	2.93 **	0.28 Ns	1.10 Ns	1.19 Ns
Number of services per conception	0.23 Ns	0.43 Ns	2.57 *	0.57 Ns	2.66 **	1.25 Ns
Open period (days)	٠,١٥ Ns	0.05 Ns	3.07 **	٠,٠٩ Ns	2.97 **	2.94 **

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 25. Effect of summer on postpartum traits in the control and the treatment groups cross bred dairy cows (X±STDEV)

Traits	Control group n=19	Treatment retained placenta group(1) n=12	Treatment retained placenta group(2) n=14	Treatment retained placenta group(3) n=12
Uterine involution process (days)	35.00 + - 7.23	٢٦,١٦ + - 7.54	28.00 + - 7.84	25.20 + - 5.70
First ovarian activity (day)	44.20 + - 13.00	64.81 + - 25.61	61.54 + - 30.01	56.50 + - 30.60
Occurrence of first postpartum oestrus (day)	61.30 + - 22.20	46.65 + - 17.42	56.37 + - 20.91	45.70 + - 23.96
Number of services per conception	3.50 + - 1.41	4.15 + - 2.20	3.38 + - 1.40	3.70 + - ١,٦٤
Open period (days)	122.13 + - ٢٧,٣١	136.60 + - 29.44	121.00 + - 26.31	114.60 + - 20.23

(X±STDEV)- Data are means±standard deviation.
n=Number of animals.

Appendix 26. Effect of autumn on postpartum traits in the control and the treatment groups cross bred dairy cows (X±STDEV)

Traits	Control group n=35	Treatment retained placenta group(1) n=31	Treatment retained placenta group(2) n=19	Treatment retained placenta group(3) n=16
Uterine involution process (days)	29.63 + - 13.14	٢٤,٥٠ + - 5.50	20.81 + - 7.51	23.54 + - 4.05
First ovarian activity (day)	36.63 + - 15.10	45.50 + - 20.00	36.60 + - 16.67	40.00 + - 17.00
Occurrence of first postpartum oestrus (day)	52.66 + - 27.30	49.20 + - 24.17	51.50 + - 29.11	49.67 + - 12.60
Number of services per conception	3.03 + - 2.14	3.75 + - 1.73	3.20 + - 2.00	2.44 + - ١,٥٨
Open period (days)	113.74 + - ٣١,٢٦	115.75 + - 35.26	114.61 + - 28.51	93.60 + - 28.46

(X±STDEV)- Data are means±standard deviation.
n=Number of animals.

Appendix 27. Effect of winter on postpartum traits in the control and treatment groups cross bred dairy cows (X±STDEV)

Traits	Control group n=30	Treatment retained placenta group(1) n=20	Treatment retained placenta group(2) n=11	Treatment retained placenta group(3) n=12
Uterine involution process (days)	24.70 + - 7.43	٢٦,٦١ + - 8.70	21.15 + - 8.51	21.00 + - 4.13
First ovarian activity (day)	35.27 + - 10.24	42.91 + - 21.00	44.08 + - 21.37	34.60 + - 11.41
Occurrence of first postpartum oestrus (day)	49.43 + - 22.27	40.58 + - 16.61	46.00 + - 24.03	41.38 + - 11.27
Number of services per conception	2.70 + - 2.00	2.80 + - 1.40	2.83 + - 1.80	2.70 + - ١,٢١
Open period (days)	112.80 + - ٣٦,١٣	105.40 + - 34.33	113.37 + - 26.38	94.70 + - 16.15

(X±STDEV)- Data are means±standard deviation.
n=Number of animals.

Appendix 28. Effect of summer on postpartum traits in the control and the treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	29	٣١	٢٩	٢٤	٢٢	٢٤
Uterine involution process (days)	٣,٢٣ **	2.62 *	4.19 **	0.61 Ns	٠,٣٥ Ns	1.05 Ns
First postpartum ovarian activity (day)	2.57 *	2.03 *	1.32 Ns	0.30 Ns	0.72 Ns	0.42 Ns
Occurrence of first postpartum oestrus (day)	2.04 Ns	0.65 Ns	1.81 Ns	1.29 Ns	0.12 Ns	1.20 Ns
Number of services per conception	0.91 Ns	0.24 Ns	0.34 Ns	1.04 Ns	0.56 Ns	0.50 Ns
Open period (days)	١,٣٨ Ns	0.12 Ns	0.87 Ns	١,٤٢ Ns	2.14 *	0.70 Ns

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 29. Effect of autumn on postpartum traits in the control and treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	64	٥٢	٤٩	٤٨	٤٥	٣٣
Uterine involution process (days)	٢,١١ *	3.14 **	2.49 *	1.86 Ns	٠,٦٨ Ns	1.37 Ns
First postpartum ovarian activity (day)	2.01 *	0.01 Ns	0.68 Ns	1.69 Ns	0.98 Ns	0.59 Ns
Occurrence of first postpartum oestrus (day)	0.55 Ns	0.14 Ns	2.14 Ns	0.29 Ns	1.59 Ns	1.46 Ns
Number of services per conception	1.51 Ns	0.29 Ns	1.10 Ns	1.00 Ns	2.61 *	1.25 Ns
Open period (days)	٠,٢٤ Ns	0.10 Ns	2.27 **	٠,١٣ Ns	2.33 **	2.17 **

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.

Appendix 30. Effect of winter on postpartum traits in the control and treatment groups cross bred dairy cows- Comparison of means

Traits	C-G1	C-G2	C-G3	G1-G2	G1-G3	G2-G3
Degree of freedom	48	٣٩	٤٠	٢٩	٣٠	٢١
Uterine involution process (days)	٠,٨٠ Ns	1.22 Ns	2.05 *	1.69 Ns	٢,٤٥ *	0.05 Ns
First postpartum ovarian activity (day)	1.51 Ns	1.31 Ns	0.18 Ns	0.15 Ns	1.45 Ns	1.31 Ns
Occurrence of first postpartum oestrus (day)	1.61 Ns	0.41 Ns	1.55 Ns	0.67 Ns	0.16 Ns	0.58 Ns
Number of services per conception	0.20 Ns	0.20 Ns	0.00 Ns	0.04 Ns	0.21 Ns	0.20 Ns
Open period (days)	٠,٧٣ Ns	0.05 Ns	2.27 *	٠,٧٢ Ns	1.19 Ns	2.02 Ns

C - Control group.
G1- Treatment group (1).
G2- Treatment group (2).
G3- Treatment group (3).
T-test is significant at 0.05 level (2-tailed).**
T-test is significant at 0.01 level (2-tailed). *
Ns- Not significant.